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DIAGNOSIS OF BRONCHIAL CARCINOMA: A CLINICAL AND ROENTGENOLOGIC STUDY OF 50 CASES[1]

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IT IS generally believed that prognosis would be improved in malignancy of the viscera if the diagnosis were made earlier. In order to determine the clinical and roentgenologic features of carcinoma of the bronchus which might be helpful in early diagnosis, 50 cases, seen on the x-ray service of Dr. Willis F. Manges, have been studied. This series should not be considered a new group of bronchial cancers; for some of them have been included in groups reported previously from other angles, notably the diagnostic by McCrae, Funk, and Jackson (1), the Radiologic by Manges (2,3,4), and the bronchoscopic and pathologic by Clerf and Crawford (5). The study is wholly diagnostic, no attempt having been made to analyze the results of treatment. The diagnosis in each instance has been based on the histologic examination of tissue removed from the tumor.

Forty-nine patients were examined bronchoscopically by Dr. Louis H. Clerf, and the tissue which he removed was studied histologically by Dr. Baxter L. Crawford or Dr. Carl J. Bucher. In the one patient not examined bronchoscopically, the diagnosis was based on the examination of material obtained at necropsy. The following histologic diagnoses were made: carcinoma, undifferentiated, 24 or 48 per cent; squamous-cell carcinoma, 23 or 46 per cent; adenocarcinoma, 3 or 6 per cent (Table I).

TABLE I.—HISTOLOGIC CLASSIFICATION

	No.	%
Squamous-cell carcinoma	23	46
Adenocarcinoma	3	6
Carcinoma, undifferentiated	24	48

TABLE II.—AGE-SEX*

	No.	%
21–30	4	8
31–40	9	18
41–50	16	32
51–60	15	30
61–70	6	12

* 45 Males, 5 females.

The cases have been analyzed as to the sex and age of the patients, the first symptom, duration of the first symptom before medical examination, general symptomatology, roentgenologic findings, differential diagnosis, and histologic types.

SEX AND AGE

Forty-five patients were males, and five females.

The ages ranged from 21 to 69 years, 62 per cent being between the ages of 41 and 60; the number in each of these decades was about the same (Table II). The high incidence in the fifth and sixth decades is similar to that found in cancer in other localities.

[1] Presented before the Radiological Society of North America, at the Twenty-first Annual Meeting, in Detroit, Dec. 2–6, 1935.

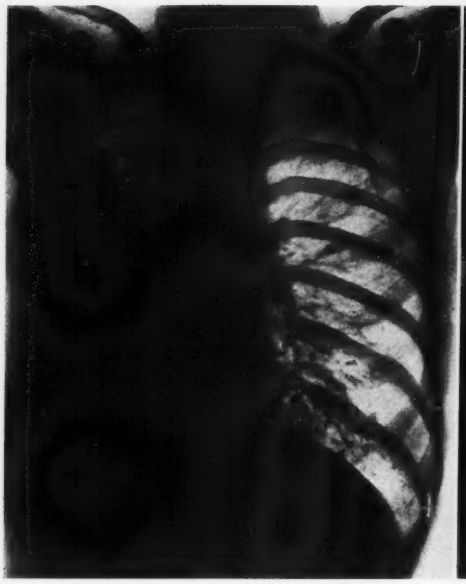

Fig. 1.

Fig. 2.

Fig. 1. J. E. F., male, aged 51 years, a patient of Dr. Louis H. Clerf, who removed the tissue bronchoscopically; it was diagnosed squamous-cell carcinoma by Dr. Carl J. Bucher. The lower portion of the right lung is markedly increased in density due to atelectasis. The heart is completely displaced to the right. There is atrophy of the right half of the chest.

Fig. 2. H. J. F., male, aged 41 years, a patient of Dr. Louis H. Clerf, who removed the tissue bronchoscopically; it was diagnosed as squamous-cell carcinoma, by Dr. Baxter L. Crawford. There is an increase in the density of the lower half of the right chest; the heart is displaced to the right; the right half of the diaphragm is elevated.

SYMPTOMATOLOGY

The most frequently encountered symptom was cough, and all but one patient complained of it. Expectoration, pain, dyspnea, loss of weight, and hemoptysis were the next most frequently encountered symptoms (Table III).

TABLE III.—INCIDENCE OF SYMPTOMS

	Present	Absent	Not Recorded	Percentage Present
Cough	49		1	98
Expectoration	34	4	12	68
Pain	30	6	14	60
Dyspnea	27	3	20	54
Loss of weight	26	5	19	52
Hemoptysis	24	4	22	48
Elevated temperature	14	2	34	28
Wheeze	6		44	12
Night sweats	6	1	43	12
Huskiness	3		47	6
Dysphagia	1		49	2

Cough, in addition to being constantly present, was the most frequently encountered initial symptom, and was recorded in 40 per cent of the cases (Table IV). It was described variously; in some individuals it was of a dry, hacking character, in others, loose and productive. It also occurred as the symptom of onset, in combination with some other symptom, in eight patients (five times with hemoptysis, twice with expectoration, and once with fever), so that it may be said to have been part of the initial symptom-complex of the disease in 28, or 56 per cent, of the patients (Table V). Its duration varied; one patient, 21 years of age at the time of the first medical observation, said that it had been present four years. In general, it was not regarded as a serious symptom and many endured it for three, six, nine months, or a year before seeking medical treatment.

Expectoration was present in 68 per cent of the cases (Table III). It was not listed as the first symptom by any patient, but was reported in combination with cough

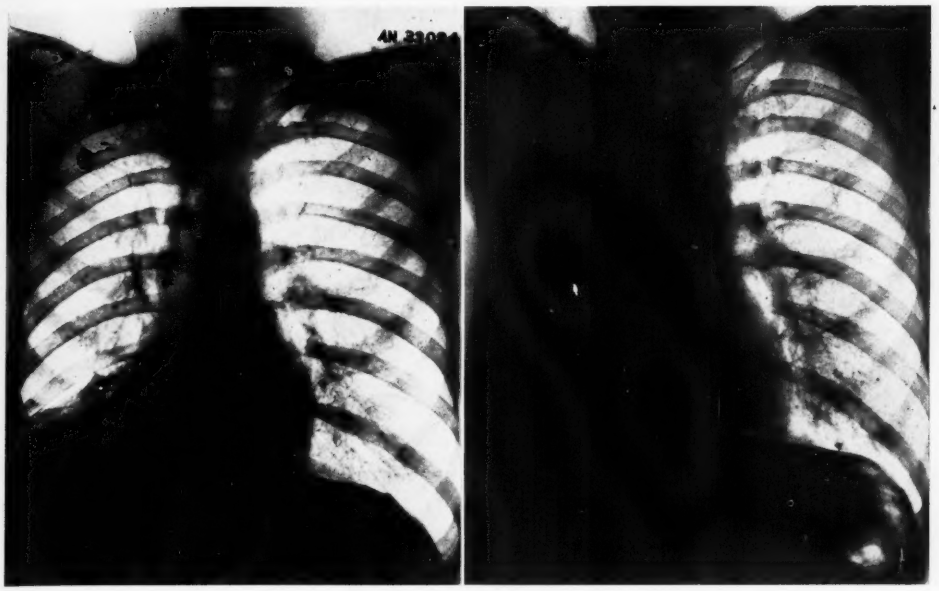

Fig. 3-*A*. Fig. 3-*B*.

Fig. 3-*A*. R. S., male, aged 44 years, a patient of Dr. Louis H. Clerf, who removed the tissue bronchoscopically; it was diagnosed as squamous-cell carcinoma of the bronchus by Dr. Baxter L. Crawford. There is a triangular area of increased density at the right cardiophrenic angle, with displacement of the heart and trachea to the right. Compare with Figure 3-*B*.

Fig. 3-*B*. Compare with Figure 3-*A*, same patient, six months later when, due to an increasing degree of bronchial occlusion, much of the right lung has become airless, its density increased, and the trachea is more displaced than it was earlier.

as the initial symptom by two patients (Table V).

Pain, the third most frequently encountered symptom, was recorded by 30, or 60 per cent, of the patients (Table III). Its character and location varied; in some patients it occurred as a constant dull ache, in others as an intermittent and recurring pain, and in some it was severe. Pain was the first symptom in four cases; it was located in the chest by two patients, in the back by one, and in the shoulder by another (Table IV). It was not ignored as long as the cough, the longest interval between the onset and the first medical examination being one year. In one patient, who complained of pain as the initial symptom, there was destruction of the ribs and a pulmonary abscess at the time of the first roentgenographic examination (Fig. 7); in another there was an associated effusion; in another a mass in the lung well away from the pleura, and in the fourth atelectasis of an upper lobe.

TABLE IV.—FIRST SYMPTOM

	No.	%
Cough	20	40
Acute respiratory infection	9	18
Cough with hemoptysis	5	10
Pain	4	8
Loss of weight and strength	2	4
Cough with expectoration	2	4
Hemoptysis	2	4
Cough with fever	1	2
Hemorrhage	1	2
Dysphagia	1	2
Unknown	3	6

Dyspnea was a symptom in 27 cases or 54 per cent (Table II). It did not occur as an initial symptom. The high incidence of dyspnea is explained by the high incidence of changes leading to diminution of the volume of functioning pulmonary tissue (Table VII). Cardiac displacement is often associated with atelectasis and may account in some measure for shortness of breath.

One of the most constantly encountered symptoms of cancer in any location is loss

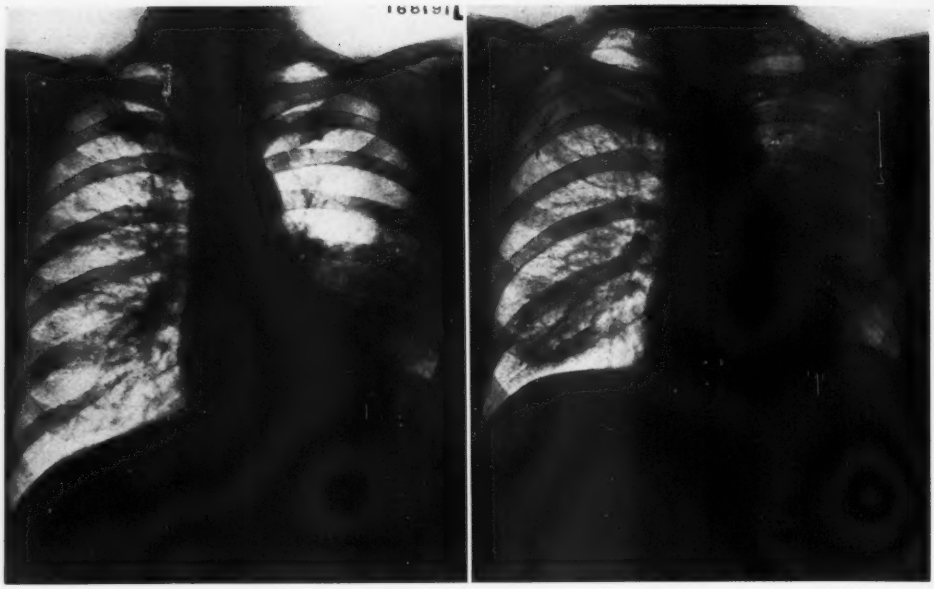

Fig. 4-*A*. Fig. 4-*B*.

Fig. 4-*A*. J. Z., male, aged 38 years, a patient of Dr. Louis H. Clerf, who removed the tissue bronchoscopically; it was diagnosed as squamous-cell carcinoma by Dr. Baxter L. Crawford. There is an increase in the density of the left lower lobe markings, with elevation of the diaphragm. Compare with Figure 4-*B*.

Fig. 4-*B*. Compare with Figure 4-*A*, same patient, five weeks later. Note the increase in the density of the pulmonary markings and the higher elevation of the diaphragm.

of weight and strength. Cancer of the bronchus is not an exception and was recorded in 26, or 52 per cent, of the patients (Table III). However, it occurred only as an initial symptom in two cases (Table IV).

Blood-spitting is a common symptom of pulmonary disease and occurs in carcinoma of the bronchus. Twenty-four, or 48 per cent, of the patients reported some form of hemoptysis, varying from the expectoration of blood-streaked sputum to massive hemorrhage (Table III). Only one patient complained of massive hemorrhage; the others estimated the amount of blood expectorated as a teaspoonful or less. Hemoptysis did not occur frequently as the first symptom (Table IV); only three, or 6 per cent, of the patients said it was the symptom of onset, though five listed it in association with cough, so that the total incidence was eight, or 16 per cent (Table V).

Fever, as evidenced by elevated temperature, was present in 14 patients (Table III); only one patient recorded it, in combination with cough, as the symptom of onset (Tables IV and V).

The incidence of wheeze as a symptom is higher than might be expected (Table III). While it did not occur as the primary symptom, six patients found it sufficiently marked to mention it. Its presence or ab-

TABLE V.—COUGH AND HEMOPTYSIS AS FIRST SYMPTOMS

Cough	20	
Cough with hemoptysis	5	56%
Cough with expectoration	2	
Cough with fever	1	
Hemoptysis	2	16%
Hemorrhage	1	

TABLE VI.—TIME FROM ONSET TO FIRST MEDICAL EXAMINATION

	No.	%
1– 3 months	8	16
3– 6 "	6	12
6–12 "	9	18
1– 2 years	15	30
2– 3 "	5	10
3– 4 "	2	4
4– 5 "	1	2
Indeterminate	4	8

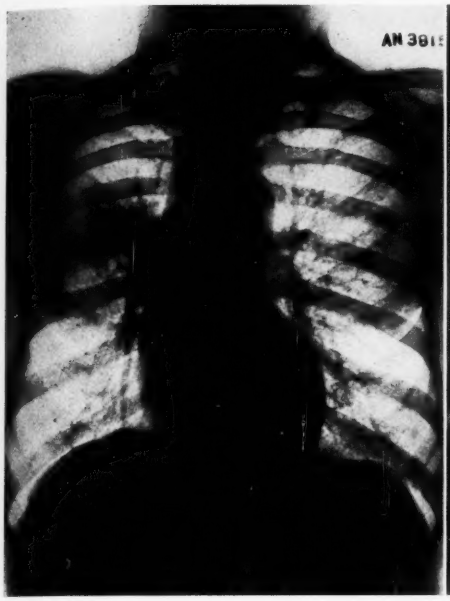

Fig. 5.

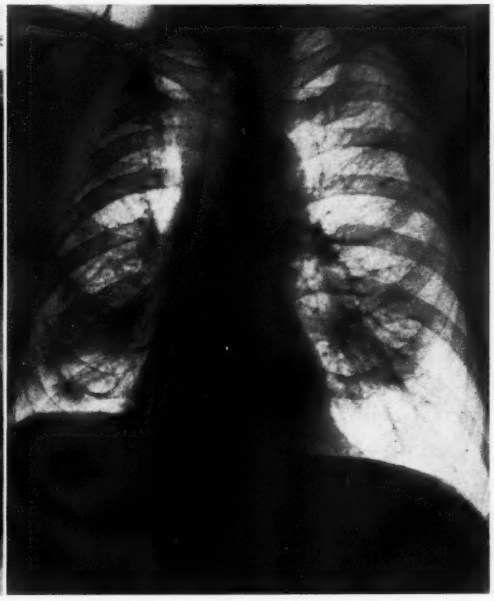

Fig. 6.

Fig. 5. R. R., male, aged 48 years, a patient of Dr. Louis H. Clerf, who removed the tissue bronchoscopically; it was diagnosed as squamous-cell carcinoma by Dr. Baxter L. Crawford. There is an increase in the linear markings radiating from the right hilum, which resemble inflammatory changes and were so diagnosed. There is some displacement of the heart to the right, and a slight elevation of the right half of the diaphragm. Changes not typical of bronchial neoplasm.

Fig. 6. E. G., male, aged 53 years, a patient of Dr. Louis H. Clerf, who removed the tissue bronchoscopically; it was diagnosed as squamous-cell carcinoma by Dr. Baxter L. Crawford. There are increased linear markings in the right lower lobe, with displacement of the heart, trachea, and diaphragm to the right.

sence was not recorded in 44 histories, indicating that it was not generally inquired into. Its relatively high incidence in this series of cases is so striking that one is led to believe that if its presence or absence were routinely determined it would be found more often.

Night sweats were present in six patients, huskiness in three, and dysphagia in one (Table III). Only dysphagia occurred as an initial symptom; this was in a man 47 years of age who had a complete collapse of the left lung, which at postmortem examination proved to be due to a squamous-cell carcinoma of the left bronchus.

Nine patients suffered from symptoms which they were unable to label, so far as onset is concerned, as a single definite symptom; their symptoms may be described as recurring attacks of acute respiratory infection. These patients had "colds" or "grippe." None of them recorded this symptom-complex except as the symptom of onset (Table IV). As the initial symptom, "acute respiratory infections" occupies second place in the table of incidence, nine, or 18 per cent, of all patients reported that the first evidence of their disease was this symptom-complex. In other words, in these patients no single symptom was sufficiently severe to attract attention to the condition, and yet the individual was not well and felt that his symptoms were due to respiratory disease.

TABLE VII.—ROENTGENOLOGIC CHARACTER

	No.	%
Atelectasis	20	40
Increased linear markings	14	28
Mass	12	24
Abscess	3	6
Pleural effusion	1	2

DURATION BEFORE MEDICAL EXAMINATION

Much has been written about delay in treatment as a cause of the high mortality

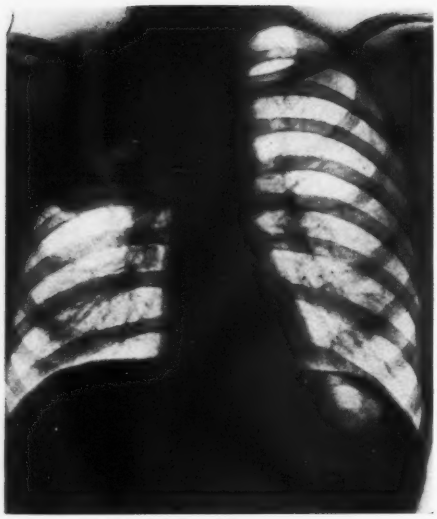

Fig. 7. L. V. S., male, aged 32 years, a patient of Dr. Clerf, who removed the tissue bronchoscopically; it was diagnosed as squamous-cell carcinoma by Dr. Baxter L. Crawford. There is an abscess with cavity and fluid level in the right upper lobe; the second and third ribs are destroyed in the axillary portion. There is a slight displacement of the trachea to the right.

in malignancy, and there is a tendency to blame physicians for the delay. However, it should be obvious that if patients fail to seek medical advice for the symptoms from which they suffer proper treatment cannot be instituted.

The time interval between the onset of the first symptom and the first medical examination has been studied to determine the duration of the disease before medical advice was sought (Table VI). The first symptom of which the patient complains is the first subjective manifestation of the disease, though in most instances the tumor would probably have been present longer.

In more than half the patients the initial symptom had been present a year before the patient consulted a physician. Only 14, or 28 per cent, sought medical advice within six months of the onset of the first symptom. Of 28 patients, in whom cough, or cough in association with some other symptom, was the initial symptom, only seven, or 25 per cent, came under medical observation within six months of the onset of the symptom. Indeed, more than half (15, or 53.5 per cent, of the patients with this initial symptom) were not seen until after the cough had been present for a year or more. As pointed out in the consideration of symptomatology, when pain was the initial symptom the patient sought medical advice earlier.

When the patient gave a history of repeated respiratory infections as the symptom of onset, there was also a long interval between the onset and the first medical consultation. Of these nine patients, only two gave a history of less than a year; seven stated that they had noticed the recurring infections for more than a year.

ROENTGENOLOGIC CHARACTERISTICS

The most constant roentgenologic finding is evidence of collapse of a lung or a lobe or part of a lobe, for in the final analysis bronchial neoplasms are foreign bodies and produce the changes of foreign body (Table VII). Jackson has likened foreign bodies to valves of two types, first, those of the check-valve type which produce partial bronchial occlusion, and second, those of the stop-valve type, producing complete occlusion. The roentgenologic findings of both types have been best described by Manges (6 and 7). The check-valve type of foreign body, producing only partial occlusion, allows air to enter the lung during inspiration but prevents its egress at expiration; the stop-valve, by producing total occlusion, prevents both entrance and exit of air.

At onset, bronchial neoplasms undoubtedly act as check-valve foreign bodies, but, unfortunately, at this stage the symptoms are not sufficiently severe to cause the patient to seek medical advice. Only one patient in this series was examined during the stage of partial bronchial occlusion; he is the only patient in the author's experience who came under medical observation during this stage of the disease. In children, partial occlusion due to the inhalation of a foreign body is accompanied by severe respiratory and constitutional symp-

toms, but adults are apparently not greatly incapacitated during the stage of partial occlusion, which must occur at the onset of the tumor. Consequently, adults do not come under medical care until the occlusion is complete, when they present the roentgenologic signs of total occlusion of the bronchus. The roentgenologic signs of complete bronchial occlusion depend upon the size of the bronchus occluded, the duration of the occlusion, and the character of the bacterial changes.

With complete occlusion of the bronchus, the air distal to the occlusion is absorbed and the lung collapses. This results in increased opacity of this portion of the lung, displacement of the heart and other mediastinal structures toward the side of the occlusion, and elevation of the diaphragm on this side (Figs. 1, 2, and 4).

Collapse of the lung or part of a lung was present in 20, or 40 per cent, of the cases (Table VII). Whenever evidence of pulmonary collapse is detected in an adult, one should consider it as due to bronchial occlusion of neoplastic origin until the presence of neoplasm has been excluded.

A mass was seen in the pulmonary fields in 12, or 24 per cent, of the cases. While the roentgenologic finding of a mass generally indicates the presence of newgrowth, it is impossible from this finding alone to determine the exact nature of the tumor. When situated near the hilum, it is often difficult to differentiate neoplastic masses from aneurysm because transmitted pulsation may simulate the expansile pulsation of an aneurysm.

The least characteristic of the frequently encountered changes secondary to bronchial newgrowth is an increase in the linear markings. This increase occurred in 14, or 28 per cent, of the roentgen studies. It was more often misinterpreted than any other change. In reviewing the roentgen studies as a group, it would appear that in this class of cases the signs would in all probability be wrongly interpreted again in most cases (Figs. 5 and 6). The increase in the linear markings was usually looked upon as due to some non-specific inflammatory change, though when it occurred in the upper portions of the pulmonary fields it was often diagnosed as tuberculosis, and in the lower as bronchiectasis. Displacement of the mediastinal structure sometimes occurs in these cases (Fig. 5); when it occurs one should be strongly suspicious of newgrowth though in most patients with this variety of change displacement phenomena are slight.

Evidence of pulmonary abscess was the roentgenologic finding in three, or 6 per cent, of the cases. In these patients, a cavity with fluid level surrounded by an area of increased density was found. In one patient (Fig. 7) there was evidence of obstruction of some of the ribs overlying the abscess. In abscess secondary to bronchial carcinoma there is frequently present evidence of displacement of the viscera; displacement does not usually occur in simple abscess secondary to operation or infection; therefore, when its signs are detected, and there is nothing to establish the cause of the abscess, the possibility of bronchial neoplasm should be borne in mind.

Pleural effusion is not a frequent complication of bronchial neoplasm; in this series it occurred but once, and made detection of the causative neoplasm impossible.

SUMMARY

(1) The case histories of 50 patients with carcinoma of the bronchus have been analyzed, clinically and roentgenologically. Forty-five patients were males and five were females; in 23, the diagnosis was squamous-cell carcinoma, in three, adenocarcinoma, and in 24, carcinoma, undifferentiated.

(2) Cough was practically always present, and was the initial symptom in 40 per cent of the cases. Pain, hemoptysis, and dyspnea were also important symptoms.

(3) There is a striking tendency for patients to disregard the early symptoms, more than half the patients did not seek medical advice until the first symptom had been present for a year or more.

(4) The most commonly found roentgen sign is evidence of atelectasis, which when present should be presumed to be due to intrabronchial neoplasm until another cause is found. In addition to atelectasis, there occurs an atypical increase in the pulmonary markings which resembles inflammatory change, and frequently a tumor can be recognized. Pulmonary abscess may also develop.

BIBLIOGRAPHY

(1) McCrae, T. Funk, E. H., and Jackson, C.: Primary Carcinoma of the Bronchi. Jour. Am. Med. Assn., 1927, **89,** 1140.

(2) Manges, W. F. Bronchial Neoplasms. Arch. Otolaryngol., 1930, **12,** 732–738.

(3) Idem: Primary Carcinoma of the Lung: Roentgen Diagnosis and Preliminary Report on Roentgen Therapy. Am. Jour. Roentgenol, and Rad. Ther., 1932, **27,** 858–869.

(4) Idem: An Analysis of a Group of Primary New-growths of the Lungs, Treated with Deep X-ray Therapy. Radiology, 1934, **22,** 423–425.

(5) Clerf, L. H., and Crawford, B. L.: Bronchogenic Carcinoma. Jour. Thoracic Surg., 1932, **3,** 73–84.

(6) Manges, W. F.: Atelectasis as a Roentgen Ray Sign of Foreign Body in the Air Passages. Am. Jour. Roentgenol. and Rad. Ther., 1934, **11,** 517–523.

(7) Idem: Non-opaque Foreign Bodies in the Air Passages. British Jour. Rad., 1926, **31,** 119–149.

DISCUSSION[2]

Dr. Leo G. Rigler (closing): I was gratified to see Dr. Anspach's very beautiful demonstration of these subphrenic lesions. He has just authorized me to answer for him the question that was asked about gas.

My own personal experience is that we do not see gas very often in these cases, but there are several possibilities for its origin. He says he does not know for certain about all these cases, but patients who have had a *Bacillus coli* infection or *Bacillus proteus* infection will form gas and in some cases the gas is the result of perforation, the perforation being closed but the gas not absorbing because of the encapsulated character of the pocket under the diaphragm.

In regard to the length of time it takes for fluid to settle down, the question has been asked over and over again. In my experience there is hardly a perceptible length of time. These patients are in the upright position when they come to the x-ray department. The first film is made in that position. They are then put in the other position and promptly afterward the fluid has spread out in the manner of which I spoke. It is not a great length of time.

I do not want to discuss my own paper any more, but, if I may, I would like to say a word or two about the papers on carcinoma of the lungs. Every time I hear John Farrell or some Philadelphian talk about bronchiogenic carcinoma, I get an acute inferiority complex until I talk to somebody from Pittsburgh, New York, or some place else, because we have so much more difficulty in making this diagnosis than they do in Philadelphia.

I listened to Chevalier Jackson, Jr., a year ago at a thoracic surgery meeting and was simply amazed and left breathless at the number of cases and the accuracy of diagnosis. I would like to say, however, that it seems to me the differentiation between inflammatory occlusions of the bronchi and malignant or tumorous occlusions of the bronchi, from the roentgenogram alone, is a difficult thing.

Granted that bronchoscopy may determine this difference, our experience has been in a few cases that even the pathologic examination is not entirely accurate —that many good pathologists have difficulty in making the distinction between inflammatory lesions of the bronchial mucosa and tumors, and I know of a number of cases in which a good pathologist, who was well aware of this difficulty, made the diagnosis of carcinoma in cases the eventual fate of which indicated clearly that no carcinoma possibly could have been present.

The differentiation of residuals of pneumonia from carcinoma, just the type of case Dr. Farrell showed in which there is an increase in linear markings, it seems to me—again from the roentgenologic standpoint alone—is exceedingly difficult.

In many respects the gross pathology which is present is very similar and the atelectasis which we think of as a part of the picture of tumor also occurs in these

[2] The discussion which follows is complete so far as it was returned for publication.

so-called unresolved pneumonias or residuals of pneumonia because they get a good deal of fibrosis, a lot of retraction—just as we get with tumors. I think we would appreciate it if Dr. Farrell would enlarge upon that differentiation a little more, if there is still time.

I would like to ask one more question and that is how often he sees destruction of the rib with primary tumors of the lung. In our experience, except in cases of so-called Pancoast or pulmonary sulcus tumor, destruction of a rib from a parenchymal tumor is certainly an unusual phenomenon. Our tendency has been to assume that the tumor was pleural in origin when the rib was destroyed.

I would also like to ask whether or not he sees enlargement of the mediastinal lymph nodes to any extent in association with bronchial carcinoma. We have had the experience of seeing that in a number of cases and I think it may be used as a differential point as to the type of bronchial carcinoma that one is dealing with. Our experience is that in cases in which mediastinal lymph nodes are enlarged in connection with carcinoma, it will respond to radiation infinitely better than in other types.

CORRECT DIAGNOSIS OF THE MORE COMMON UROLOGIC LESIONS[1]

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THE common urologic lesions do not present difficult problems in diagnosis when case histories, laboratory data, and roentgen pathology are characteristic. However, these lesions sometimes become problems when the disease pattern differs from that usually accepted as characteristic, or when they are associated with other lesions and developmental abnormalities. The roentgenologist should assume the attitude of equal responsibility with the urologist in establishing a diagnosis, consult and advise with him about the type of examination most suitable to the individual lesion under study, and industriously apply himself to its solution. This substitutes tangible evidence for unnecessary speculation and assures a wholesome co-operation between the specialties.

It is the purpose of this paper to present some of the unusual manifestations of the more frequent urologic lesions encountered daily, to illustrate them with case reports, and to emphasize the procedures considered necessary for thoroughness in diagnosis.

The greater percentage of renal and ureteral calculi can be diagnosed by a reliable stereoscopic x-ray examination, because of the salts entering into the formation of these stones. Pure uric acid and cystin stones comprise a small percentage and these cannot be demonstrated on the primary roentgenogram. These soft stones can frequently be demonstrated by pyelography, urography, or pneumopyelography, since they will be visualized as negative shadows in the opaque solution and as positive shadows in air. The net result of the combined examinations is quite satisfactory. Occasionally, the roentgen diagnosis is complicated by the association of calculus and congenital abnormalities, tumors, cysts, or unusual tissue response to trauma and infection. An unqualified diagnosis of stone in such cases is inadequate. Correct interpretation of the several lesions will be quite helpful in planning treatment and may have a vital influence on the end-result.

An opaque stone may form in a major calix, causing partial obstruction and a localized hydronephrosis. The pyelogram will demonstrate the hydronephrosis and the cause. Occasionally, a small stone will completely obstruct a minor calix and cause a marked hydronephrosis of this single calix which compresses the adjacent portion of the renal pelvis. The pyelogram will demonstrate the compression deformity, and since the stone appears to be entirely removed from the pelvis, the deformity will appear as a cortical tumor containing calcification. The diagnosis is more difficult when such a stone is not opaque to the x-ray. This particular appearance of calculous hydronephrosis is rare.

Case 1. Female, aged 35 years, was admitted to the hospital, complaining of pain in the back and abdomen, and chronic constipation. There was generalized abdominal tenderness which was most marked in the right lower quadrant.

The voided urine contained an occasional pus cell and a few organisms, but no red blood cells.

The diagnosis was chronic appendicitis. Appendectomy, uterine suspension, and resection of the left ovary for hemorrhagic cyst were performed. During convalescence, she suffered from abdominal and bladder pains, frequency, and terminal dysuria. She was dismissed on the twenty-seventh post-operative day, apparently much improved.

She was re-admitted six days later, complaining of pain in the left kidney region and bladder, frequent and burning urination, and chills and fever. There was

[1] Presented before the Radiological Society of North America, at the Twenty-first Annual Meeting, at Detroit, Dec. 2–6, 1935.

Fig. 1. Fig. 2.

Fig. 1. Case 1. (*A*). Compression deformity of cephalic portion of kidney pelvis from localized hydronephrosis, as a result of the stone completely obstructing a lesser calix. (Arrow points to stone.) Deformity simulates tumor. (*B*). Same kidney after stone was passed and recovered from bladder. Lesser calix now demonstrated; note evidence of infection.

Fig. 2. Case 2. (*A*). Oval, translucent filling defect in renal pelvis, caused by polyp. Roentgenographic diagnosis was soft renal calculus. (*B*). Increased kidney damage from pyelitis and hydronephrosis. No change in size, shape, or position of filling defect. (*C*) Evidence of increased kidney damage; no change in negative shadow.

marked tenderness in the left upper quadrant. The temperature was 99.8 degrees Fahrenheit. The x-ray diagnosis was stone in the left kidney. Cystoscopy revealed bladder congestion and 4 c.c. of residual urine in the left kidney. The right kidney specimen contained an occasional red blood cell and a few gram-negative diplococci; the left, from 35 to 40 red blood cells, from 8 to 10 pus cells, and a few gram-negative bacilli and diplococci. The culture of the urine from the left kidney showed *B. coli*. A left pyelogram showed the shadow, interpreted as a stone, to lie apparently outside the pelvis, and the upper calix compressed as from a cortical tumor containing calcification (Fig. 1-*A*). P.S.P. function was 53 per cent over a three-hour period. Chills, high fever, and pain in the left upper quadrant continued for eight days. The temperature then gradually returned to normal, and the patient was dismissed on the twenty-ninth day with normal temperature and free of pain.

Three months later she was re-admitted with the same symptoms as described above, but greatly increased in severity. The voided urine contained pus and blood. Leukocytes were 16,700, with 95 per cent polymorphonuclears. Temperature varied from 99 to 104 degrees for 18 days. Tenderness persisted over both kidneys, being more intense first over the right, then over the left; abdominal distention was marked. On the twelfth day, the pain radiated to the left groin. A small stone the size of a cherry seed was recovered from the bladder. A right pyelogram showed a pyelitis and a hydronephrosis, which was most marked in the cephalic calyx. A recheck pyelogram of the left kidney showed the stone absent, the compression deformity on the pelvis to have disappeared, and a small calyx connecting with the cephalic infundibulum by a narrow short neck at the point where the stone had previously been demonstrated (Fig. 1-*B*). Final urine cultures showed *B. pyocyaneous* from each kidney. She was dismissed with a normal-

appearing bladder, moderate pyuria, and free of symptoms.

This patient has recently returned to the hospital complaining of high blood pressure and failing vision. The urologic check-up now shows a small, contracted, and poorly functioning left kidney, and a hydronephrosis and infection of the right kidney. The prognosis seems gloomy.

A negative shadow in the pyelographic media is abnormal. The causes which most frequently must be considered in the differential diagnosis are: air bubble, nonopaque stone, blood clot, and papilloma, and less frequently, polyp. The pyelogram should be carefully studied for negative shadows before the ureteral catheter is removed, and a logical plan of procedure should be determined immediately to permit of securing additional information if it is necessary. This will avoid unnecessary repetition of cystoscopy and ureteral catheterization.

The air bubble is quite frequently observed in a pyelogram. This is an unnecessary source of speculative diagnosis, as a repetition of the examination with correct technic will establish the nature of the shadow and prevent its interpretation as a serious lesion.

Repeated examinations, preferably after hematuria has ceased, will often establish a blood clot as the cause of a negative filling defect in the pelvis or ureter.

The differential diagnosis between pure uric acid or cystin stone, papilloma, and polypoid tissue is more difficult. A clinical history of renal colic, a negative shadow in the pyelogram which may or may not shift position on repeated examinations, and a definite scratch on a waxed bulb catheter indicate stone. However, the scratch on the wax-tipped catheter alone is not absolutely diagnostic of stone as being the cause of the filling defect, for there may be both calculi and space-filling tissue in the same pelvis. The filling defect may be too indefinite for diagnosis of a kidney lesion; in such cases a pneumo-pyelogram may show the lesion with more clarity and permit a positive and correct diagnosis. If a pneumo-pyelogram is contra-indicated, a helpful procedure is to decrease gradually the strength of the pyelographic media until the shadow is excluded or shown with sufficient detail to permit diagnosis.

The differential diagnosis between polyp and papilloma will probably not be made until pyelotomy or nephrectomy have been performed and the specimens studied microscopically. The polypoid tissue may appear grossly papillomatous at the operating table and the kidney may be removed on this assumption. If one realizes that the suspicious-appearing tissue may be a simple polyp, a quick section may avoid an unnecessary nephrectomy. When the aggregate number of cases is considered, polyps do not present a common urologic problem, but they should be considered as a cause of the negative filling defect in the pyelogram. The following is an illustrative case.

Case 2. Male, aged 41 years, was admitted to the hospital complaining of burning urination, frequency, and hematuria. The physical examination was essentially negative. Pus, blood, and a few organisms were found in the voided urine. A pyelogram of the right kidney showed an oval translucent filling defect in the pelvis, which was interpreted as a renal calculus (Fig. 2-*A*). Two days later he developed an acute right renal retention, accompanied by pain in the right upper quadrant and back, kidney tenderness, and localized muscle spasm. Cystoscopic examination showed a congested bladder, and on attempting to pass a catheter up the right ureter, an obstruction was met at the uretero-pelvic juncture which was difficult to pass; 30 c.c. of very dark, turbid material were aspirated from this kidney. The catheter was anchored. Cystoscopy and pyelography were repeated later; the filling defect was in the same location and of the same size, and progressive damage to the kidney was shown by increased hydronephrosis and evidence of infection (Fig. 2-*B*). The patient had a severe reaction following this examination and the catheter had to be re-anchored, at which time a

Fig. 3.

Fig. 4.

Fig. 3. Case 3. (*A*). Normal right kidney. (*B*). Enlarged, irregular left kidney, with compression and displacement of mid-portion of the renal pelvis, due to multiple cysts of the kidney. Roentgenographic diagnosis of tumor was made.

Fig. 4. Case 4. (*A*). Large circular mass in lower pole of the left kidney, and numerous stones. Roentgenographic interpretation was calculous pyonephrosis. (*B*). Contracted pelvis, hydronephrosis of lesser calices, enlargement of lower renal pole, and displacement of ureter. Roentgenographic diagnosis was calculous pyelonephritis and solitary cyst or perirenal tumor.

small cystin stone was found in the bladder. However, the patient's condition did not permit surgical intervention. Two months later, cystoscopy and a right pyelogram were repeated. There had been no change in the negative shadow, but the hydronephrosis had increased (Fig. 2-*C*).

The patient finally responded to supportive treatment and the kidney was explored. The regular loin incision was made and the renal pelvis was carefully palpated for stone; none was found. A pyelotomy failed to reveal a stone. A pair of forceps was inserted into the kidney pelvis, and on opening and closing, a piece of tissue was brought out which seemed papillomatous. It was then decided to remove the kidney. Probing of the specimen failed to locate a stone. Sections showed no evidence of tumor, but aggregations of small cystin stones, shot-size, beneath the mucosa of the calices, and one small stone in a minor calix.

Although stones were found, the filling defect which had been attributed to stone was really caused by the polyp. The stones had never been demonstrated on the roentgenogram.

Carcinoma of the kidney pelvis secondary to chronic irritation from renal calculi and infection has been recorded. Infrequently renal cysts and stones are associated. Secondary changes, as pyelitis, pyelonephritis, and pyonephrosis, plus the tumor deformity, make it difficult to evaluate correctly the pathologic entity. If possible, correct diagnosis of stone and the type of cyst should be made, as it is embarrassing to the surgeon to have the first intimation of a polycystic kidney after it has been delivered for a nephrectomy.

The following case illustrates the association of stone and polycystic kidney, and emphasizes the necessity for accurate preoperative diagnosis.

Case 3. Male, aged 45 years, was referred to the author for a gastro-intestinal examination because of vague abdominal pain and loss of appetite and weight. He had never had renal pain, hematuria, or frequency. There were no palpable masses.

The gastro-intestinal tract was normal, but a left renal calculus and an enlarged left kidney were observed; he was admitted for urologic investigation. The physical examination was negative. The

blood pressure was 134/80. The urine showed a rare pus cell and a specific gravity of 1.003. The blood picture was normal. The urine from each kidney was clear, and there was no renal retention. Indigo carmine appeared from the right side in three minutes; from the left in five minutes. The right pyelogram was normal (Fig. 3-*A*). A left pyelogram showed the stone to lie in the inferior calix, and a large compression deformity on the middle portion of the kidney pelvis, with displacement of the calices, and a hydronephrosis (Fig. 3-*B*).

The roentgen diagnosis was renal calculus and tumor of the left kidney, probably hypernephroma.

At operation, multiple cysts in the kidney were found, and for the first time a polycystic kidney was intimated—the kidney all but destroyed by the cysts. A consultation was held with several urologists at the operating table, and since the right kidney was structurally and functionally normal, it was decided to remove the left because of the extensive destruction by cysts.

Pathology.—The capsule stripped with slight difficulty. Throughout the entire surface of the kidney, numerous various-sized cysts were found which contained a serous fluid free of débris or hemorrhage. Some of the cysts projected from the surface of the kidney for a centimeter or more. The cortex was well differentiated from the medulla. In the lower pole, cysts had entirely replaced the kidney structure. The cortex contained numerous regular glomeruli free of blood. Tubules were fairly uniform throughout. There was a definite slight increase in the interstitial tissue throughout the cortex and medulla, which did not obliterate cortical tissue. Irregularly distributed throughout the cortex could be seen numerous small areas of cystic structures lined by cells, which somewhat resembled endothelium. These cystic structures were surrounded by a definite amount of fibro-connective tissue.

The pathologic diagnosis was nephrolithiasis, early hydronephrosis, and polycystic kidney.

The patient made an uneventful recovery, improved in health, and remains free of symptoms. In spite of the histologic diagnosis, it is the author's opinion that this was not a polycystic kidney, but a multiple cystic kidney not of congenital origin.

Numerous unnecessary surgical procedures and prolonged medical management are occasioned by the frequent predominant gastro-intestinal symptoms accompanying renal disease, and sometimes from failure to elicit and analyze properly the case histories. The following case is an example of the difficulties encountered clinically and roentgenologically in a case of advanced pyelonephritis, nephrolithiasis, and a large solitary cyst of the kidney.

Case 4. Male, aged 45 years, was first admitted on May 21, 1933, complaining of pain in the region of a rupture he had had for 30 years. The pain had been present for one year. Physical examination showed a left indirect inguinal hernia; there were no other essential findings. An occasional pus cell was found in the voided urine. The total P.S.P. function for two hours was 55 per cent.

A left herniotomy was performed. Four months later he was re-admitted with a secondary direct left hernia which had developed three weeks earlier. Voided urine contained a large number of pus cells. A left herniotomy was done and he made an uneventful recovery. He returned again one year later with a direct left inguinal hernia, for which he was again operated upon. Voided urine contained a few pus cells.

He returned again in January, 1935, complaining of pain in the left side which he himself attributed to the herniotomies. Several weeks prior to this admission, he had consulted a physician who had discovered a mass in the left kidney region. A more careful history was secured. The patient stated that he was suffering from swelling in the left upper abdomen, pain radiating to the groin, and passage of a large quantity of urine, which occasionally followed these attacks. He had had hematuria at times with the attacks, became

nauseated, sometimes vomited, but had never passed stones. He stated that he had had these symptoms for several years. Physical examination showed a large, firm, movable mass in the left upper quadrant which was tender to pressure. The urine contained an occasional pus cell, but no blood.

K.U.B. examination showed a large left kidney, and a large circular mass with a partially calcified periphery overlying the lower pole of the kidney, and a group of stones lying above the upper margin of the mass, apparently in the kidney pelvis (Fig. 4-*A*). A pyelogram showed a markedly contracted pelvis, marked blunting and dilatation of the minor calices, and the large mass in intimate relationship with the lower pole of the kidney but not compressing or displacing the pelvis. The ureter, however, was displaced upward and medially (Fig. 4-*B*). A diagnosis of renal calculi, pyelonephritis, and perirenal tumor or solitary cyst was made. Surgery was performed through an abdominal incision and a hard mass was found in the mid-abdomen just to the left of the umbilicus. The peritoneum was greatly thickened, and there was a cystic mass measuring approximately five inches in diameter occupying the lower pole of the kidney. The entire kidney was freely movable, and normal-feeling tissue was palpated above and behind the cystic tumor. When the hard mass lying in the mid-abdomen was incised, it was found to be an abscess and it was drained. No further surgery was attempted at this time. Nephrectomy was performed ten days later. A large solitary cyst of the lower pole, numerous renal stones, and advanced pyelonephritis were found. The patient made an uneventful recovery and was dismissed free of symptoms.

The differential diagnosis between large renal cysts, post-peritoneal and perirenal tumors, and large neoplasms originating in the kidney substance itself, is sometimes quite difficult. A stereoscopic x-ray examination of the urinary tract is a necessity. The correct localization of the tumor

Fig. 5. Lateral displacement of kidney and ureter, and obstructive hydronephrosis, caused by retro-peritoneal sarcoma. Correct diagnosis from stereoscopic K.U.B. four months before mass was palpable.

and its relationship to the surrounding organs can be more accurately determined by this method than from a single anteroposterior roentgenogram. Correct analysis of data obtained will often permit a positive and correct diagnosis. Pyelography or urography is essential for confirmation, or for obtaining additional information necessary for diagnosis. Helpful information may be secured by examining the gastro-intestinal tract and determining the influence of the tumor on the stomach, small bowel, or colon. Valuable information is obtained from the lateral pyelogram, and often permits the correct diagnosis to be made when it cannot be made by any other procedure. Mertz has described the technic, analyzed the normal and abnormal appearance, and set forth the indications for the lateral pyelogram. Those interested in this study should refer to this excellent article. The lateral pyelogram is too often neglected.

Intra-abdominal tumors seldom cause rotation or displacement of the kidney, and

the ureter follows its normal course. Postperitoneal tumors may displace the kidney from side to side (Fig. 5), distort the kidney

Neoplasms of large size originating in the capsule of the kidney usually cause displacement of the kidney and ureter toward

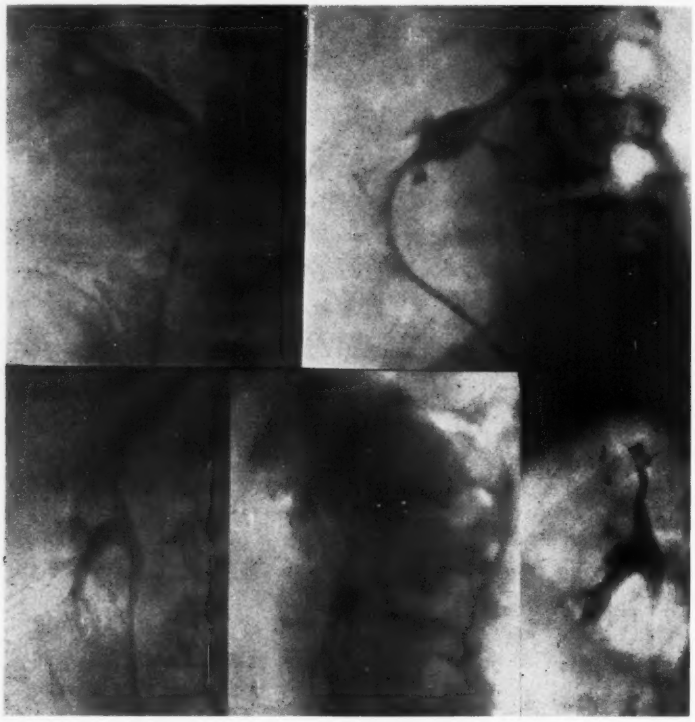


Fig. 6. Upper half of illustration shows anterior displacement, horizontal and vertical rotation of kidney, due to retro-peritoneal sarcoma, and anterior displacement of ureter. Contrast with lower half, in which case changes are due to large hypernephroma. (Lantern slide copy, courtesy of H. O. Mertz.)

pelvis, and cause an obstructive hydronephrosis, due to the pressure on the ureter, all of which will be demonstrated on the anteroposterior pyelogram. The lateral pyelogram will show downward and anterior displacement, horizontal and vertical rotation of the kidney, and anterior displacement of the ureter (Fig. 6).

Primary renal tumors of cortical origin tend to displace the kidney pelvis upward, with little if any anterior displacement, and varying degrees of horizontal rotation, but always considerable vertical rotation. Large cysts arising posteriorly may displace the kidney slightly forward, but there is scarcely any displacement of the ureter from its normal course.

the opposite side and downward. Large tumors arising in the substance of the kidney may displace the ureter when they are located in the lower pole. The influence on the renal pelvis constitutes an important differential diagnostic point between capsular and cortical tumors. In large capsular tumors, the pelvis is usually displaced toward the opposite side and downward, and is elongated and hydronephrotic, but shows little if any compression deformity (Fig. 7). In large cortical tumors causing displacement of the ureter, the renal pelvis is displaced upward and is compressed, and may be fragmented (Fig. 8).

Bacterial inflammation of the kidney is classified as pyelitis, pyelonephritis, or pyo-

nephrosis, depending on the portion of the kidney involved and the extent of the disease. Etiologic factors which the roentgenologist most frequently must consider are calculi, ureteral strictures, fascial bands or aberrant blood vessels, and anomalies of the kidney and ureter. Stones may perforate the kidney pelvis and give rise to a suppurative nephritis, which is usually demonstrated in the form of pyelitis and pyonephrosis. A pyelonephritis of this nature may be demonstrated and the renal pelvis appear normal, as the relationship between stone, abscess, and pelvis cannot be definitely demonstrated (Fig. 9). The stone may completely perforate the kidney and form a fistulous tract between the kidney and adjacent organs. If surgery is performed at an opportune time, the stone will be recovered in a mass of granulation tissue adherent to the peritoneum and viscera just short of perforation of a viscus. When a fistula between the kidney and a portion of the gastro-intestinal tract is suspected, it can sometimes be established or excluded by doing a pyelogram and an examination of the suspected viscus with the barium suspension at the same time. By this procedure, we have been successful in definitely excluding the presence of fistula in several suspected cases.

The following case illustrates an advanced pyelonephritis in which the pelvis of the kidney appears normal in spite of extensive infection and perforation of the kidney by a stone which was recovered, adherent to and perforating the colon.

Case 5. Female, aged 32 years, was admitted in November, 1934, and delivered of a normal male child. She had had no urinary difficulties during pregnancy.

Seven years prior to this admission she had had pain in the right side and appendicitis was suspected. An x-ray examination showed a stone in the right kidney, and pus was found in the urine. She had had fever for several days, but had improved on general medical management, and from that time to the present had not had symptoms referable to the kidneys.

She was re-admitted approximately three weeks after delivery, complaining of generalized abdominal pain, chills, and fever. Pain was constant in the right side and radiated over the entire abdomen. Temperature was usually over 100 degrees, and at the time of chills became elevated to 106 degrees. The temperature on admission was 99 degrees; pulse 100; respiration 20. There was tenderness in the left costovertebral angle. The clinical diagnosis was left renal calculus and pyelonephritis.

Fig. 7. Large perirenal fibromyxosarcoma of the right kidney. (Courtesy of B. H. Nichols.)

Urine was cloudy and contained much pus, blood, an occasional cast, and many bacteria. Hemoglobin was 48 per cent; red blood cells 2,390,000; leukocytes 30,900; polymorphonuclears 95 per cent; small lymphocytes 3 per cent; large lymphocytes 1 per cent; myelocites 1 per cent. The K.U.B. showed several stones in the kidney pelvis and one lying in the kidney parenchyma. A diagnosis of calculous pyonephrosis was made.

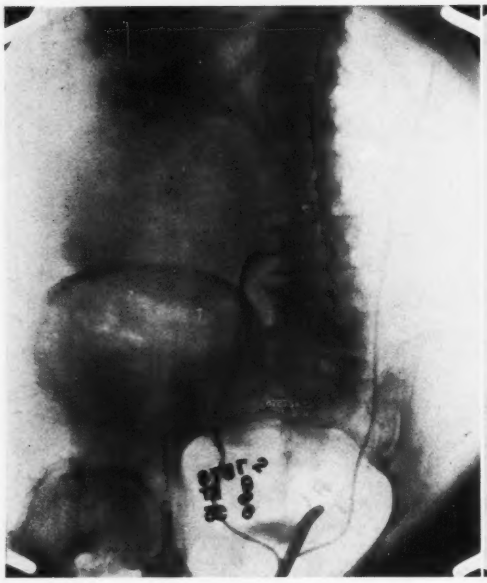


Fig. 8. Large hypernephroma of lower pole. Contrast influence on kidney pelvis with Figure 7.

Fig. 9. Case 5. Stone perforating kidney, and pyelonephritis. Stone, adherent to and perforating colon, was recovered. Fistula between renal pelvis and abscess not definitely demonstrated: normal cupping of lesser calices.

The bladder was congested, and cloudy green urine was obtained from the left kidney. The x-ray diagnosis was left nephrolithiasis, parenchymatous abscess, and a stone in the kidney substance (Fig. 9). The minor calices showed good cupping; the relationship between the stone, abscess, and pelvis could not be demonstrated. The stone in the parenchyma was entirely removed from the abscess.

In January, 1935, a left nephrectomy was performed. The kidney was considerably enlarged and densely adherent anteriorly. In separating these adhesions, a necrotic area was located where the peritoneum and the colon were attached to the kidney by granulation tissue. A small calculus was found in this tissue, which had almost perforated the colon.

Pathology.—Grossly, on the surface of the kidney there was a roughened area appearing necrotic and to which the capsule was adherent. There were three small stones in the kidney pelvis. At the end of one of the calices a small hemorrhagic area was found which seemed to be a fistulous sac communicating with the exterior at the point of necrosis. The pathologic diagnosis was nephrolithiasis and chronic suppurative nephritis. There was no evidence of tuberculosis or malignancy.

In the author's experience the diagnosis of perinephritis and renal carbuncle is seldom definitely established from the pyelogram alone. The indirect aid of the x-ray examination in these cases is to exclude calculus, osteo-arthritis of the hip and spine, acute osteomyelitis, etc. The history of a pyogenic infection followed by pain in the loin or hypochondrium, fever, loin tenderness or mass, leukocytosis, and the information from chemical and bacteriologic studies of the separate kidney urines usually establish the diagnosis of perinephritis or renal carbuncle. The x-ray may be of direct aid, since fluoroscopy will demonstrate disturbance of movement and position of the diaphragms; roentgenograms will demonstrate functional lateral spinal curvature toward the side of the le-

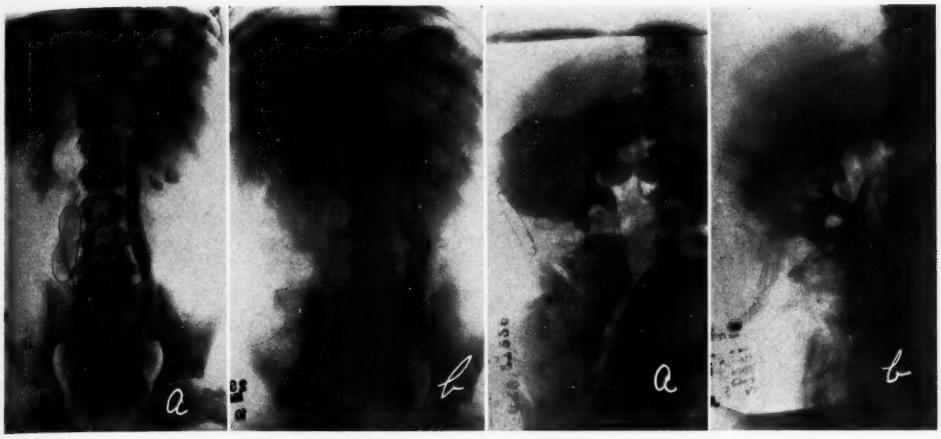


Fig. 10. Fig. 11.

Fig. 10. Case 6. (*A*). Bilateral hydronephrosis and hydro-ureters, caused by congenital ureteral valves. There is a deformity of the left renal pelvis from renal carbuncle, which was interpreted as tumor. (*B*). After incision and drainage of renal carbuncle.

Fig. 11. Case 7. (*A*). Barium enema and pyelogram superimposed, showing relationship of lower pole of kidney to area of colon deformity. Note serration of bowel wall. (*B*). Abscess cavity injected with sodium iodide, and pyelogram superimposed, showing relationship of perinephric abscess and lower pole of kidney.

sion, lack of distinctness of the psoas muscle shadows, contiguous inflammatory changes in the base of the lung on the side involved, and occasionally definite compression deformities on the kidney pelvis and displacement of the colon as revealed by the pyelogram and the barium enema, respectively. When the compression deformity and the displacement of the abdominal viscera are present, the evidence from the pyelogram simulates that of tumor of the kidney. Interpretation is further complicated when there are associated congenital anomalies, bilateral infected hydronephrosis and ureteritis, and there is slight symptomatic response to the infectious process.

Case 6 demonstrates the unusual combination of bilateral congenital ureteral valves and a renal carbuncle, Case 7, the deformity and contiguous inflammation of the colon caused by a perirenal abscess, infra-renal in location.

Case 6. Male, aged 11 years, was admitted to the hospital complaining of loss of weight, pain in the back, passage of large quantities of urine, blood and pus in the urine, nausea, and vomiting. The onset began six weeks prior to admission, with pain located chiefly in the right side. A history of a pyogenic process prior to the onset of kidney symptoms was not obtained. The temperature was 100 degrees; pulse 130; respiration 28. The head, chest, and lungs were negative. No masses were palpable in the abdomen. The right kidney was tender; the left was not. Urine was cloudy and contained pus and blood; specific gravity was 1.014. Hemoglobin was 65 per cent; red blood cells 3,660,000; leukocytes 14,900; polymorphonuclears 89 per cent; small lymphocytes 11 per cent. P.S.P. function was 55 per cent over a period of two hours. The bladder was negative. Both ureters were catheterized, and 10 c.c. of hazy residual urine were recovered from the right kidney; the urine from the left kidney was clear. The kidney specimens were negative for tubercle bacilli.

K.U.B. showed a large left kidney. Bilateral pyelograms showed a large hydronephrosis and marked ureteral dilatation on each side, the point of obstruction being at the ureterovesical orifices, and a large compression deformity on the pelvis and calices of the left kidney (Fig. 10-*A*). The

Fig. 12. Primary papillary carcinoma of the bladder, invading the lower end of the left ureter. Must be differentiated from artefact, air bubble, blood clot, and soft stone.

Fig. 13. Case 10. Large sacculated hydronephrosis, resulting from obstruction at uretero-pelvic juncture due to aberrant blood vessel.

x-ray diagnosis was bilateral congenital ureteral valves, with bilateral hydronephrosis and hydro-ureter, and a cortical tumor of the left kidney.

Exploration showed a carbuncle of the left kidney, infection located in the posterior surface. In this area the kidney was densely adherent to the surrounding tissues, so that it was freed with a great deal of difficulty. Elsewhere perinephritis was very slight. After freeing the kidney, a cone-shaped crater was found, about one inch in diameter and one-half inch in depth. *Staphylococcus aureus* was obtained from the culture of the pus. Repetition of the pyelogram showed the compression deformity of the kidney pelvis, but to a lesser degree (Fig. 10-*B*).

The patient was dismissed from the hospital after six months, much improved, with only a slight drainage from a sinus which had formed in the left loin. Last reports from him indicate considerable improvement and freedom from symptoms.

Case 7. Male, aged 65 years, was admitted to the hospital in September, 1935. Six weeks previously, he had pierced a finger of the left hand with a thorn. This was followed by a localized abscess which had to be lanced, after which it gradually healed. Two weeks later he had severe pain in the right lower chest. The chest was strapped and the pain decreased somewhat, but it had been more or less severe up to the time of admission. He vomited occasionally. The physical examination showed temperature of 102 degrees, pulse 90, respiration 20. There was tenderness in the right costovertebral angle, and some muscle spasm. Voided urine contained a small amount of pus and an occasional red blood cell. The hemoglobin was 65 per cent; red blood cells 3,600,000; leukocytes 15,000; polymorphonuclears 92 per cent. Agglutinations for typhoid, tularemia, and undulant fever were negative. Blood culture was sterile. Urine was negative for tubercle bacilli. An x-ray examination of the urinary tract was negative. A chest roentgenogram showed an inflammatory process at the base of the right lung, characterized by pleurisy, exudation, slight fibrosis, and a

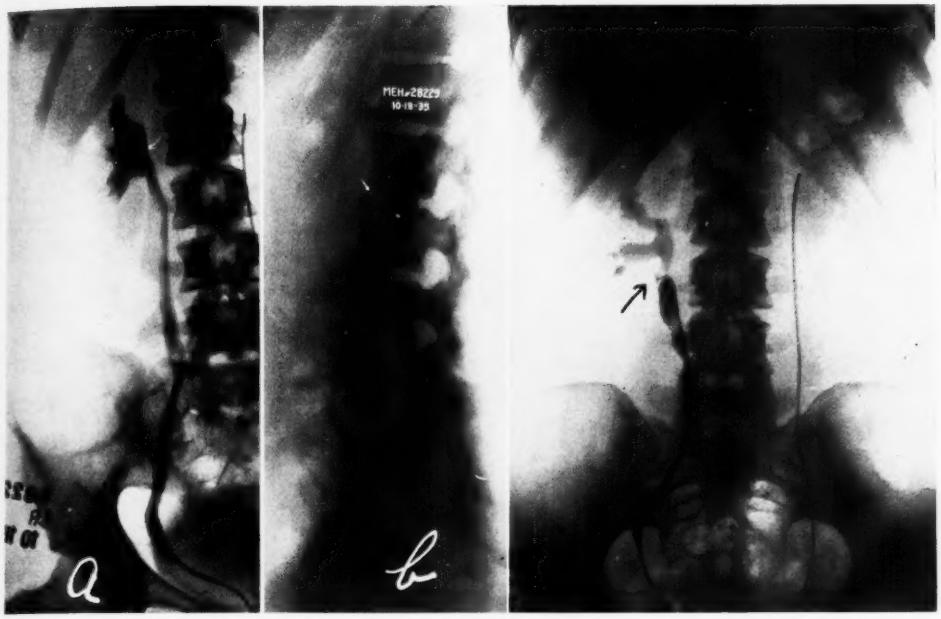


Fig. 14. Fig. 15.

Fig. 14. Case 11. (*A*). Slight hydronephrosis; anteroposterior pyelogram does not permit positive diagnosis of ureteropelvic juncture obstruction. (*B*). Lateral pyelogram shows early sacculated hydronephrosis and lesion at uretero-pelvic juncture, probably an aberrant vessel.

Fig. 15. Case 12. Aberrant blood vessel from lower pole of kidney, interpreted as ureteral stricture because of apparent low position, stone in renal pelvis, and pyelitis.

small amount of pleural effusion. Stereoscopic examination of the liver area showed what appeared to be superficial shallow abscesses of the liver immediately beneath the diaphragm. A barium enema showed the hepatic flexure to be displaced forward, downward, and medially, and an irregularly serrated border adjacent to the compression deformity (Fig. 11-*A* and *B*). These changes were attributed to a soft tissue abscess extrinsic to the colon. Incision and drainage of the perinephric space was done and approximately eight ounces of pus were obtained, cultures of which showed *Staphylococcus aureus*. Three weeks later, an injection of the fistulous tract and a right pyelogram were done at the same time. This examination showed a normal renal pelvis, and an abscess cavity lying immediately below and enveloping posteriorly and laterally the lower pole of the kidney, the position corresponding to the location of the deformity on the colon. Convalescence was fairly rapid after incision and drainage of the perinephritic abscess, and the patient was dismissed two weeks later.

One must frequently make a differential diagnosis between lesions causing nonopaque shadows in the ureter. The plan of procedure is essentially the same as that for studying such negative shadows in the kidney, but substituting the ureterogram for the pyelogram (Fig. 12).

The passing of a ureteral stone is frequently checked radiographically. A stone impacted at the ureterovesical orifice may occasion a serious error in diagnosis. The lower end of the ureter and the ureterovesical orifice may become markedly edematous from trauma and cause considerable "pouting" into the bladder. In the roentgenogram the stone appears entirely too far anterior to be in the ureter, and the relative position as shown by comparison with previous films has definitely changed.

The illusion is further increased by stereoscopic roentgenograms. Unless one considers this possibility he will sometimes the obstruction is allowed to remain indefinitely, irreparable damage to the already diseased kidney may result from this error.

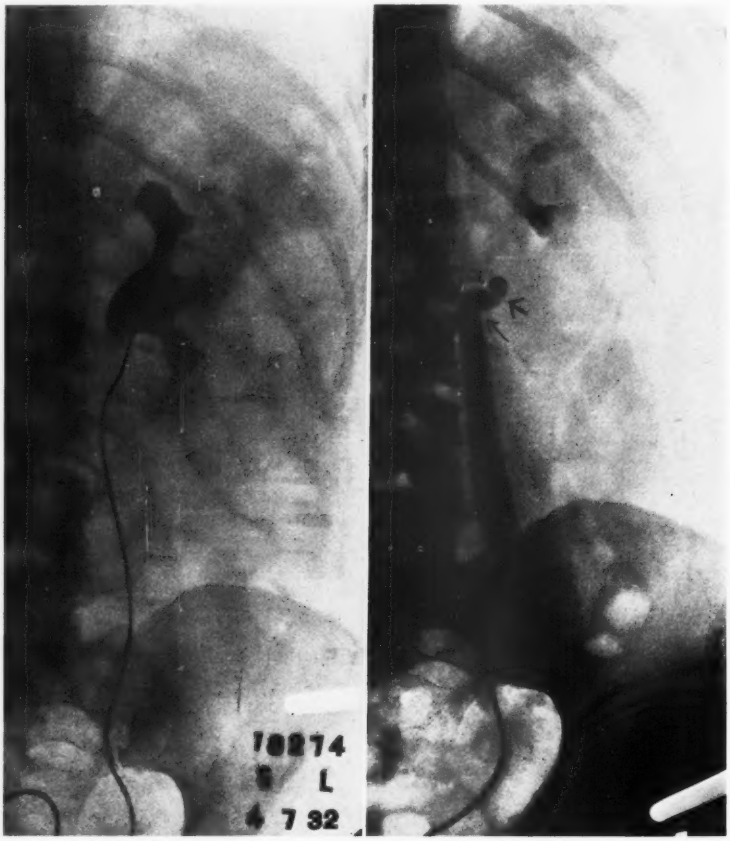


Fig. 16. Case 13. Anomalous blood vessel, causing atrophy and fibrosis of upper end of ureter. There is no anatomic connection with the renal pedicle; nephrectomy is necessary.

make a diagnosis of an ureteral calculus passed to the bladder; surgery will be canceled, symptoms will continue, and straining of the urine will fail to recover the stone. Cystoscopy and passage of a ureteral catheter reveal the edema and show the stone to occupy relatively the same position in the ureter as at the previous examination. Variable positions of the ureterovesical orifice must also be considered, particularly the ureter terminating high up in the bladder instead of at the base. If

Case 8. Male, aged 33 years, was admitted to the hospital complaining of intermittent attacks of pain in the right upper quadrant and back which radiated downward. There was tenderness and muscle rigidity in the right upper quadrant. Voided urine contained pus and blood. A right pyelogram showed an obstructive hydronephrosis and a stone in the upper end of the right ureter. Repetition of the x-ray examination three days later showed the stone to have descended to a point ap-

proximately three inches above the ureterovesical orifice. Two days later he complained of colicky pain in the right lower quadrant radiating to the scrotum and medial surface of the thigh. Another x-ray examination showed the stone to have descended a little farther in the ureter. He was dismissed and the position of the stone checked at regular intervals. When it seemed that the stone would not pass spontaneously, it was decided to remove it surgically. A stereoscopic examination secured just before surgery showed that it had apparently passed to the bladder and lay along the anterior wall. Surgery was canceled, but symptoms continued and straining of the urine failed to recover a stone. A cystoscopic examination showed marked edema and "pouting" of the ureterovesical orifice; passage of a ureteral catheter showed the stone to be in the lower end of the ureter. The apparent anterior position of the stone as demonstrated by the stereoscopic x-ray was caused by the marked edema and "pouting" of the ureterovesical orifice, which carried the stone forward but it still remained in the ureter. The patient finally passed the stone after dilatation of the ureter with seaweed, and has remained free of symptoms.

The etiology of ureteral strictures may be considered as inflammatory and developmental. Among the developmental defects causing stricture-like formation are vascular or fibrous bands, and kinks due to movable kidneys. Previous infection or trauma result in strictures and adhesions, the latter often simulating organic strictures. Intermittent hydronephrosis, infection, and calculus may often result from the obstruction. A frequent cause of hydronephrosis, and one which can be easily misinterpreted, is the vascular band or the aberrant blood vessel. The vessel crossing the uretero-pelvic juncture is easily diagnosed when it has caused a marked dilatation and sacculation of the kidney pelvis, as this is more or less characteristic of this lesion (Fig. 13).

Case 10. Female, aged 23 years, entered the hospital with pain in the left upper quadrant and left lumbar region. Onset began two weeks prior to admission. The pain began in front and radiated to the back, was dull in character and intermittent. The patient was unable to urinate during the attacks of pain. She had had similar attacks since childhood, but had not had one for three years prior to present illness. A physical examination showed the thyroid to be palpable; the heart and lungs were negative. There was a palpable, tender mass in the left upper quadrant, with some rigidity. Urine showed a slight trace of albumen and no pus. Hemoglobin was 80 per cent; red blood cells 4,090,000; leukocytes 12,350; polymorphonuclears 85 per cent; small lymphocytes 14 per cent; eosinophiles 1 per cent.

Cystoscopic examination showed the bladder mucosa injected, but no other evidence of bladder pathology; 800 c.c. of residual urine were recovered from the left kidney. Pyelograms showed bilateral aberrant vessels at the uretero-pelvic junctures, moderate hydronephrosis of the right pelvis, and a very large hydronephrosis of the left pelvis and calices. The left kidney was infected; the cortex could not be identified.

A culture of the urine from the right kidney was negative; that from the left showed *B. coli*. P.S.P. function test showed 5 per cent from the left catheter; 44 per cent in the bladder. No acid-fast bacilli could be found.

A nephrectomy was performed and an elongated kidney was found covered with many adhesions, also, an adventitious vessel to the upper and lower poles of the kidney. There was a large sacculated pelvis. The pathologic diagnosis was hydronephrosis and pyelitis. The post-operative course was uneventful, and the P.S.P. on dismissal was 62 per cent.

The earlier degrees of hydronephrosis may be easily overlooked and the patient subjected to numerous surgical procedures because of pain in the side, before the real cause of the symptoms is found. In suspicious cases, in which the anteroposterior

pyelogram fails to show the changes due to the aberrant vessel, a lateral pyelogram will sometimes demonstrate the location of the vessel and the early stages of hydronephrosis (Fig. 14-*A* and *B*). Plastic surgery will prevent marked kidney damage and avoid unnecessary operations.

Case 11. Female, aged 24 years, was admitted to the hospital complaining of chills, high fever, frequency, weakness, and constipation. She had had an appendectomy a month earlier, without relief of symptoms. The physical examination showed the blood pressure to be 108/70; temperature 99.4 degrees. Urine contained pus, blood, and many bacteria. Hemoglobin was 62 per cent; red blood cells 3,290,000; leukocytes 11,800; polymorphonuclears 84 per cent. The K.U.B. was normal. A urogram showed poor function and an obstructive hydronephrosis on the right side, the exact type of which could not be determined because of poor visualization. A retrograde pyelogram of the right kidney was advised. The anteroposterior view was not conclusive; the lateral showed a deformity of the ureteropelvic juncture and a hydronephrosis characteristic of an aberrant blood vessel.

The patient refused operation and was treated symptomatically. She improved and was dismissed under observation. She is to return later for a plastic operation on this kidney.

Although this case has not been confirmed by operation, it shows the value of the lateral pyelogram in the investigation of early uretero-pelvic lesions.

All aberrant blood vessels are not confined to the uretero-pelvic juncture proper, but may cross from the lower pole of the kidney and appear low down on the ureter and simulate stricture, especially when the pelvis is incompletely filled and there is evidence of stone and infection (Fig. 15).

Case 12. Female, aged 36 years, entered the hospital complaining of cramping pains in the upper abdomen, nausea, and some pain and burning on urination. Temperature was 101.6; pulse 100; respiration 20; blood pressure 130/90. The chest and heart were normal. There was some tenderness to deep palpation midway between the right costal margin and the iliac crest. A firm mass was palpated in the right upper quadrant, which was movable and felt like kidney. Urine showed pus and a few bacteria. Hemoglobin was 78 per cent; leukocytes 9,300; polymorphonuclears 84 per cent; lymphocytes 16 per cent; P.S.P. function 56 per cent. A cholecystogram revealed a normal gall bladder, also a right renal calculus, and the patient was referred to a urologist.

A wax-tipped catheter showed bruising but no definite scratch after passage up the right ureter. A right pyelogram showed a calculus in the lower pole of the kidney, and dilatation of the ureter. There was a stricture just below the uretero-pelvic juncture.

A pyelolithotomy and lysis of the ureter were done. The kinking of the ureter was maintained by a fair-sized blood vessel which traversed the sheath of the ureter below the uretero-pelvic juncture. This was severed. A stone 1 cm. in diameter was removed, which was flat and free in the pelvis.

Constrictions of the ureter may be caused by anomalous vessels limited entirely to the upper end of the ureter, as illustrated by the following case.

Case 13. Female, aged 38 years, was admitted to the hospital complaining of severe pain in the left flank. She had previously had an appendectomy, a uterine suspension, and finally a complete hysterectomy. The heart and lungs were normal. There was some tenderness over the left kidney region and gall bladder. Urine was acid in reaction, cloudy, contained pus, an occasional red blood cell, and a few organisms. Hemoglobin was 85 per cent; red blood cells 4,100,000; white blood cells 9,650; polymorphonuclears 75 per cent; eosinophiles 1 per cent; small lymphocytes 23 per cent; large lymphocytes 1 per cent. P.S.P. function was 59 per cent for two hours.

The bladder media was cloudy, and there was slight edema of the left ureteral

orifice and some petechial hemorrhage on the left side. The right ureteral orifice was normal. A left ureteral catheter was obstructed near the uretero-pelvic juncture. One ounce of urine was aspirated from the left kidney. A left pyelogram showed the pelvis incompletely filled, marked dilatation of the distal portion of the ureter, and a corkscrew-like deformity of the upper end of the ureter between the dilatation and the kidney pelvis. The impression was an aberrant blood vessel of the upper end of the ureter (Fig. 16). The pre-operative diagnosis was left hydronephrosis.

Operation was performed and the ureter freed of all adhesions. The pathology involving the ureter consisted of a distinct angulation and two marked constrictions situated less than one-half inch apart, caused by a vessel spiraling around the upper end of the ureter. Immediately beneath the vessel the ureter was markedly constricted, and there was marked dilatation between the areas of narrowing. The kidney was removed, since any plastic operation would have necessitated the resection of that portion of the ureter involved, and the ureter was too short to accomplish this. The post-operative diagnosis was angulation of the ureter, aberrant blood vessel, and fascia bands. The pathologic diagnosis was chronic infectious nephritis.

This case illustrates an important point in technic of pyelography in cases of aberrant vessels, the ureter being injected with the tip of the catheter below the vessel; otherwise the hydronephrosis alone and not the cause will be shown and the location missed.

SUMMARY

It has not been the purpose of this discussion to develop in its entirety any one particular phase of roentgenological urology. We have considered briefly some common urologic lesions which are comparatively easy to diagnose when the investigation is thorough and characteristic criteria are present, but become difficult when they are associated with other lesions or cause unusual roentgen manifestations. The necessity for thorough investigation and the types of examinations available to be applied to the solution of a particular problem have been emphasized and briefly outlined. Accuracy in x-ray diagnosis can be attained only by an intelligent selection and application of the examination most suitable to the individual case, and by a conscientious and industrious application of the roentgenologist himself to the solution of the problem.

We wish to express our appreciation to the urological staff of the Methodist Hospital for permission to use their cases in this report.

REFERENCE

MERTZ, H. O.: The Lateral Pyelogram: A Neglected Procedure in the Diagnosis of Various Abdominal Conditions. Jour. Ind. St. Med. Assn., Oct. 15, 1931, **24**, 537–540.

THE ROENTGEN DIAGNOSIS OF LESIONS OF THE LOWER URINARY TRACT[1]

By C. L. GILLIES, M.D., *and* H. D. KERR, M.D., *Iowa City, Iowa*

From the Department of Radiology, University of Iowa

THE roentgen ray has been used in the diagnosis of the lesions of the lower urinary tract since the year of its discovery. Improvements in technic over the first flat anteroposterior plates of the bladder area have gradually developed until at the present time they have reached a comparatively high state of perfection.

These advances in technic may be listed briefly as follows:

(1) The opaque cystogram; used first in 1902, by Zeissl and Holtzknecht, in cadavers, and later (1905) in the living subject by Wulff.

(2) The air cystogram; described in 1904 by Keller, of Vienna, and used successfully by him to demonstrate bladder diverticula.

(3) The anterior urethrogram; first employed by Cunningham, in 1910, to demonstrate strictures.

(4) The satisfactory posterior urethrogram. Haudek, in 1921, demonstrated that the posterior urethra can be satisfactorily visualized only by injecting opaque fluid during the exposure of the radiograph.

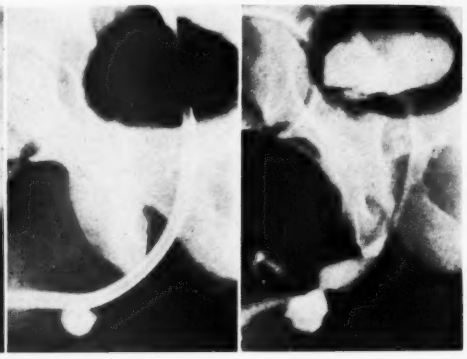
(5) The dorsal decubitus position, with the patient at a 45-degree angle with the horizontal, for the study of the posterior urethra. Described by Béclère and Henry, in 1922.

(6) The use of a very radiopaque nonirritating fluid (lipiodol), which was employed by Sicard and Forestier, in 1924.

(7) The substitution of a lipiodol gum tragacanth jelly for opaque liquids in urethrograms, which was described by Flocks, in 1933.

A *B*

Fig. 1. (*A*). Normal urethrogram, demonstrating the bulbous, membranous and prostatic portions. (*B*). Stricture of urethra, showing narrow irregular lumen.



A *B*

Fig. 2. (*A*). Opaque calculus in bulbous urethra, in contact with catheter. (*B*). Urethrogram accurately localizes calculus, and shows peri-urethral abscess and inflammatory stricture.

It appears that almost without exception and regardless of methods used, those who have reported upon the use of contrast substances in the radiographic study of the lower urinary tract have been very enthusiastic about its diagnostic aid. To these opinions we wish to add our whole-hearted support.

However, in spite of these many favorable reports, with the exception of the anteroposterior film and the opaque cystogram, these studies are not generally employed. This has no doubt been largely due to the rapid development of the cysto-

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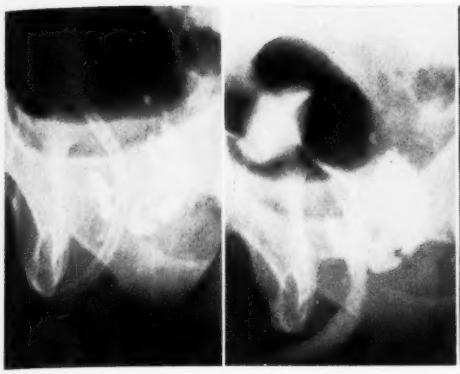
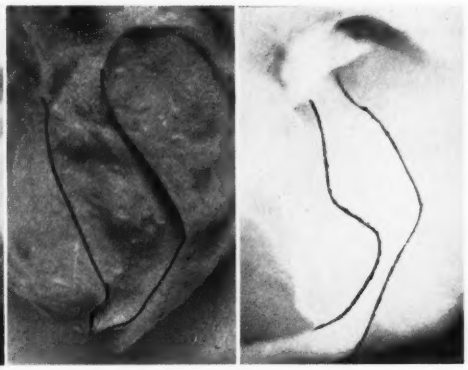


A *B*

Fig. 3. (*A*). Marked calcification within the prostate. (*B*). In addition, the urethrogram demonstrates a prostatic abscess.



A *B*

Fig. 4. (*A*). Sagittal section of specimen, showing distortion of urethra by hypertrophy of lateral and posterior commissural tissue. (Urethra outlined in ink.) (*B*). Similar deformity demonstrated by a urethrogram. This illustrates how a lateral lobe enlargement produces flattening, while posterior commissural hypertrophy causes anterior tilting of the urethra.

scope and its universal adoption by specialists in diseases of the urinary tract.

The procedures employed at the State University of Iowa Hospital are those introduced by R. H. Flocks, under the direction of N. G. Alcock, of the Department of Genito-urinary Surgery, and in our opinion represent a combination of all previous advances in technic plus, first, the substitution of lipiodol jelly for opaque fluids in visualization of the urethra, and second, the distinct advantage of making urethrograms in combination with air cystograms.

The routine examination consists of the following five radiographs:

(1) Flat anteroposterior scout film of the urinary tract.

(2) Flat anteroposterior sodium iodide cystogram.

(3) Stereoscopic 45-degree right oblique air cystogram.

(4) Flat 45-degree right oblique urethrogram, with air-filled bladder. For the better study of bladder tumors and diverticula, oblique opaque cystograms and air cystograms in the anteroposterior and left oblique positions are occasionally made.

Such a complete study reveals information about the urethra, prostate, bladder, and ureters (in case of reflux), which cannot always be obtained cystoscopically, and has the distinct advantage of making a permanent record, the value of which is obvious in following the course of any disease involving these organs.

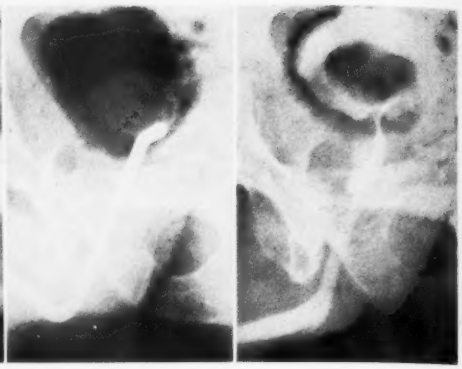
The examination is easily made, and when carefully carried out does not appear to be attended with danger, a point that will be disputed by some in regard to the possibility of air embolism in the making of air cystograms. However, over two thousand such examinations have been made by the Department of Genito-urinary Surgery in the past three years, without fatality or any untoward symptoms directly or indirectly attributable to air embolism.

The interpretation of cysto-urethrograms may logically be discussed under three headings: (1) the anterior urethra; (2) the posterior urethra; (3) the bladder.

Anatomically, except during micturition, the anterior urethra is a collapsed tube, extending from the external meatus to the prostatic urethra, a distance of from 14 to 17 centimeters. When filled, it becomes a smooth cylinder of nearly uniform diameter throughout the greater portion of its length. Posteriorly, it first widens slightly, to form the bulbous portion which curves sharply upward, and then narrows rapidly to end in the membranous portion,

A *B*

Fig. 5. (*A*). Specimen of combined hypertrophy and carcinoma. In spite of the marked prostatic enlargement, the urethra remains narrow. (*B*). Urethrogram of similar condition, which shows close conformity to pathologic specimen. Diagnosis confirmed microscopically.



A *B*

Fig. 6. (*A*). Spherical shadow in bladder, due to hypertrophy of the sub-cervical gland of Albarran. (*B*). In addition, the urethrogram shows a slight flattening of the urethra from lateral lobe pressure.

which, except for the external meatus, is the narrowest portion of the entire urethra.

The urethra is well demonstrated by urethrography, and any lesion altering its contour is at once apparent. Stricture, which is the most common lesion of the anterior urethra, is graphically demonstrated and accurately located by employing this method of study. It usually occurs in the bulbous portion and is characterized by a sharp constriction, often accompanied by an irregular contraction of the lumen for a considerable distance distal to the stricture.

Peri-urethral abscesses are also frequently found in the posterior portion, and are well demonstrated by an irregular extravasation of opaque material into the abscess cavity. The urethrogram accurately localizes the point of origin, the size of the abscess cavity, and the direction of penetration into the soft tissues.

Foreign bodies and calculi are occasionally found in the urethra and, if opaque, are of course visible on the plain film. If non-opaque they will be demonstrated as filling defects on the urethrogram.

The membranous urethra is a narrow undistensible band about 1.5 cm. in length, which serves as a land mark in separating the bulbous from the prostatic urethra. It is rarely involved by disease.

The prostatic or posterior urethra extends from the external sphincter to the bladder neck, normally a distance of about three centimeters. Except during micturition, its walls also lie in contact. When filled, as is well shown by urethrograms exposed during injection, it is spindle-shaped, with a small rounded eminence—the verumontanum—located on the posterior wall at the widest portion.

From the intimate relationship of the posterior urethra to the prostate as it passes through this organ, it is obvious that any disease process changing the size and shape of the prostate will also change the size and contour of the prostatic urethra, and it is upon these changes, together with the appearance of the bladder neck, that lesions of the prostate can be diagnosed by cysto-urethrography. That certain diseases deform the prostate and the urethra in a definite and characteristic manner is well known from a study of anatomic and operative material. (Wilson and McGrath, Randall, and others.)

With simple prostatic hypertrophy, there are, practically speaking, three pure types. The resulting deformity of the urethra is directly dependent upon the type and degree of enlargement. First, lateral lobe hypertrophy causes lateral pressure on the urethra, so that it becomes flattened

A

B

Fig. 7. (*A*). Urethrogram, showing flattening of urethra from lateral lobe pressure, and, also, anterior tilting from posterior commissural hypertrophy. (*B*). Urethrogram of same patient, following transurethral resection. Lumen is now adequate with no evidence of obstruction.

A

B

Fig. 8. (*A*). Uniform narrowing of the prostatic urethra. No filling defect in the bladder base. Findings are those of carcinoma of the prostate. (*B*). A second case of carcinoma of the prostate, with elongated straight but narrow urethra. A small irregular filling defect may be seen in the base of the bladder.

to a longitudinal slit in its lateral diameter and greatly increased in its anteroposterior diameter. It also elongates with the increased superior-inferior enlargement of the prostate. The second type is posterior commissure or middle lobe enlargement; as this portion of the gland enlarges, it projects into the bladder and causes from its posterior position a sharp anterior tilting of the prostatic urethra. A third type of hypertrophy involves the sub-cervical gland of Albarran, which, as it enlarges, forms a small ball of tissue projecting into the bladder above the internal sphincter, immediately behind and above the outlet. This does not deform the urethra but by its position acts as a ball valve, producing a mechanical block to urination.

Frequently in prostatic hypertrophy, the enlargement is not confined to one or two lobes but represents varying combinations of each.

Carcinoma typically produces a phlegmonous infiltration of the gland, which elongates the urethra and narrows it by pressure around the circumference. The gland is not as large as in simple hypertrophy, and is often irregular, which may be apparent at the bladder neck, in the urethra, or in both locations.

In the so-called median bar formation, the prostate is not enlarged, but as the result of chronic infection a fibrosis occurs at the bladder neck, with resulting stenosis of the internal urethral orifice. Our experience indicates that this condition either does not occur as frequently as has been observed on anatomic studies or else we do not always recognize it.

With some cases of cord bladder, the internal sphincter loses its tone and becomes relaxed.

Oblique urethrograms, in combination with air cystograms in the living subject, graphically show these changes observed on anatomic and operative material, as follows:

(1) In hypertrophy of the lateral lobes, the prostatic urethra is elongated and flattened in its lateral diameter, with corresponding increase in its anteroposterior diameter.

(2) With hypertrophy of the posterior commissure, the urethra is tilted sharply forward, producing an angulation, the apex of which is directed posteriorly.

(3) With enlargement of the sub-cervical gland of Albarran, there is but little deformity of the prostatic urethra, the enlarged gland itself being visible in the bladder base, blocking the urethral outlet.

(4) In carcinoma of the prostate, there is

A B

Fig. 9. (*A*). Urethrogram, demostrating a median bar. The prostatic urethra is narrowed at the bladder neck by a posterior fold of tissue. (*B*). Dilated smooth cylindrical prostatic urethra, found in some cases of cord bladder.

A B

Fig. 10. (*A*). Air cystogram, showing large carcinoma in the base of the bladder. (*B*). Air cystogram of same patient, following resection of tumor.

typically a rather small irregular filling defect in the base of the bladder; the prostatic urethra is elongated and narrowed, with an irregular lumen. Carcinoma unfortunately does not always produce characteristic diagnostic changes. At times, it cannot be distinguished from simple hypertrophy, and occasionally confusion may arise when both conditions are present at the same time.

(5) A median bar shows no elongation of the posterior urethra or prostatic enlargement in the base of the bladder. The internal urethral orifice is narrowed by a band or fold of tissue encroaching upon its lumen posteriorly.

(6) Prostatic abscess, if communicating with the urethra, is demonstrated by the actual filling of the abscess cavity with the opaque medium.

In certain cases of cord bladder, the internal sphincter may relax, causing the internal urethral orifice to be funnel-shaped. In these cases the prostatic urethra is smooth and loses its fusiform shape to become more cylindrical.

Since opaque cystograms are in general use, it seems unnecessary to discuss their application in the diagnosis of bladder diverticula, tumors, ureteral reflux, etc.

Concerning the use of air cystography we quote from a paper by Pfahler, published in 1919, in which he states: "This method is not new, . . .but it seems to me a method that is not used sufficiently, and for this reason I am again calling attention to it. . . ."

We feel that this statement still holds good sixteen years later, and believe that air cystograms not only serve as a check on opaque cystograms, but are of superior value in the diagnosis of stones of low density and in the study of bladder tumors, including prostatic enlargement. This is because air, a less dense contrast substance, allows these lesions to stand out in striking relief without the possibility of their being partially or completely obscured by the opaque fluid.

In conclusion, we believe that a complete radiographic study of the lower urinary tract as outlined above is deserving of more general adoption, because of the following:

(1) When carefully done it is a safe procedure.

(2) The diagnostic information obtained is in many instances comparable to that obtained by cystoscopy.

(3) In some instances, an accurate diagnosis can be made by this method when cystoscopy is impossible due to arthritic deformities.

(4) The fact that a permanent record is obtained makes it of particular value in progress examinations.

We wish to express our thanks to Dr. N. G. Alcock and Dr. R. H. Flocks, of the Department of Genito-urinary Surgery, for their assistance in the preparation of this paper, and for the loan of the photographs of the anatomic specimens shown.

BIBLIOGRAPHY

(1) BÉCLÈRE, H., and HENRY, R.: Quelques Radiographies de Rétrécissements de l'Urètre. Jour. d'urol., 1922, **13,** 417–424.
(2) CUNNINGHAM, J. H.: The Diagnosis of Stricture of the Urethra by Roentgen Ray. Trans. Am. Assn. Genito-urin. Surg., 1910, **5,** 369–371.
(3) FLOCKS, R. H.: The Roentgen Visualization of the Posterior Urethra. Jour. Urol., 1933, **30,** 711–736.
(4) HAUDEK, M.: Zur Technik der Röntgenuntersuchung der Harnröhre. Wien. med. Wchnschr., 1921, **71,** 490, 491.
(5) KELLER: Quoted from WULFF.
(6) PFAHLER, G. E.: The Injection of Air for the Roentgen Diagnosis of Tumors of the Bladder. Am. Jour. Roentgenol., 1919, **6,** 371–375.
(7) RANDALL, ALEXANDER: Surgical Pathology of Prostatic Obstructions. Williams & Wilkins Company, Baltimore, 1931.
(8) IDEM: The Pathology of Bladder Neck Obstructions. Jour. Urol., 1932, **28,** 509–517.
(9) SICARD, J. A., and FORESTIER, J.: Exploration Radiographique de l'urètre au Lipiodol. Bull. et mém. Soc. Med. d. hôp. de Paris, 1924, **48,** 207–210.
(10) WILSON, L. B., and MCGRATH, B. F.: Surgical Pathology of the Prostate. Surg., Gynec. and Obst., 1911, **13,** 647–681.
(11) WULFF, P.: Verwendbarkeit der X-Strahlen für die Diagnose der Blasendifformitäten. Fortschr. a. d. Geb. d. Röntgenstrahlen, 1904–1905, **8,** 193, 194.
(12) ZEISSL, M. v., and HOLTZKNECHT, G.: Der Blasenverschluss im Röntgenbilde. Med. Bl. Wien., 1902, **25,** 155–157.

DISCUSSION

DR. ROBERT E. CUMMING (Detroit, Mich.): I assure you it is a great privilege to be with the Radiological Society. I would like very much to have had my urologic friends here to listen to this symposium and see the very excellent, instructive, and informative slides which have been shown us in such profusion.

Relative to Dr. Nichols' paper, I have very little to say. However, he stressed one of the points which was brought out by Dr. Shiflett, also, namely: The necessity for the roentgenologist to share equally with the urologist in a clinical diagnosis.

Dr. Nichols mentioned leukoplakia of the kidney pelvis as one of the causes of hematuria. Whether it is in his list of forty, I do not know. It is also one of the not-too-rare conditions which I have added to the list given in Dr. Shiflett's paper, so that you will bear with me while I read my short discussion of the latter paper.

Relative to Dr. Swick's paper, "Intravenous Urography in Children," an analysis of several hundred answers to a questionnaire relating to intravenous urography in the preparation of a paper for presentation at the last session of the American Medical Association provided me ample proof of the relative safety of this diagnostic procedure. I am unable to state the number of instances in which the method was used in juvenile patients, but of the many thousands of cases of its use reported, certainly many more than a thousand were in the young age group.

In spite of some danger, as indicated by a personal report from a confrère in Toledo (the patient was an adult and died as the direct result of intravenous urography) very recently, I believe the method is safe enough for universal application when renal function is sufficient to promise fair drug excretion. Therefore, in children especially, it may be adopted as a routine procedure in the early stages of diagnostic progress.

On the other hand, my own experience and that of others indicates that as a means of accurate diagnosis it fails in a higher percentage of cases than is true in older age groups. Only last week Dr. Mertz, of Indianapolis, in an address at Ann Arbor, stated that in only 30 per cent of instances of the employment of intravenous urography in children was the information of definite value, and that in 30 per cent it was entirely worthless. This was a part of his analysis of four hundred cases of urologic conditions in children.

Our debt to Dr. Swick and to those who sponsored his early work here and abroad is greater than I can measure in words; its benefit is lasting, and as a pioneer in the science of intravenous urography, he de-

serves the maximum of personal praise. His later efforts to produce a safer and particularly a less expensive medium are praiseworthy. Certainly his results with hippuran, which can be prepared at a cost of only sixty cents per dose, are good enough to merit more general use. I must confess that this preparation has not been of much value in my hands.

The paper of Dr. Kerr and Dr. Gillies on the "Roentgen Diagnosis of Lesions of the Lower Urinary Tract" calls our attention to the uses of contrast media, especially the new jelly-lipiodol combination, in the evaluation of bladder pathology and in particular that of the bladder outlet. Its historical account is interesting, yet I am sure that many urologists and likely many roentgenologists have used similar methods in obscure cases for many years without reporting their methods or their results. For that very reason the paper is most important.

Both urologists and roentgenologists have hitherto neglected this very fertile field of diagnostic procedure, and even yet fail to apply the facilities indicated in routine practice. For that reason, much will have to be done in the accumulation of films, the recording of clinical data and operative findings, before we are generally able to make the valuable diagnostic assumptions which Dr. Kerr tells us about.

I daresay both groups of specialists are largely ignorant of the rather fine distinctions now made in the clinic of Dr. Alcock with the aid of the authors of this paper; they are jointly worthy of much praise for popularizing urethrography.

More than fifteen years ago, working with Dr. Sosman in the Army, I accumulated a large series of seminal vesiculograms with the method described by the late Dr. Belfield. These, with additional visualization of the ampullæ and the vasa diferentia, gave one considerable information not only as to the seminal vesicles and the vasa but also as to the prostate and its relationship in position to the bladder.

A few months ago I learned that in certain of the New York clinics vesiculograms are made routinely in conjunction with bilateral vas ligation, which is done preceding prostatic surgery. By a study of the relationships between the vesicles and the bladder base, notable especially in obliquely made films, one is able to determine certain things relating to prostatic obstruction.

For instance, the vesicles normally hug closely to the bladder and are displaced very little, if at all, by lateral lobe hypertrophy of the prostate. On the other hand, if the enlargement is pronounced in the median or commissural areas and if there is a deeply placed Albarran gland hypertrophy, the vesicles will be very definitely displaced.

On the recommendation of my informer, Dr. Archie Dean, who praises the method highly, I bespeak its use by urologists and roentgenologists alike. However, I have not always found it easy to inject enough lipiodol into the vesicles for complete filling and consequent diagnostic value, and occasionally resort to collargol or other silver salts.

I was particularly interested in reading Dr. Shiflett's paper on "Common Urologic Lesions as Diagnostic Problems," because the urologists with whom he is so closely associated are among my very warmest friends. The paper, with its brief but complete case histories, brings to mind so many problems it is almost encyclopedic in its scope.

I admire the frank admission of early failures in some of the cases cited, from the standpoint of roentgen diagnostic possibilities especially, and was pleased by the author's analysis of these and his sound and constructive conclusions recorded for future use.

Some of the cases in this report may bear additional comment. The late result of operative attacks upon a kidney is always important and I believe we miss finding the marked hypoplasia which all too often occurs, even when the kidney itself is not primarily involved. I refer to developments after division of anomalous vessels, nephropexy, denervation of the renal ped-

icle, ureterolysis, and plastic surgery upon the upper ureter.

Dr. Shiflett's case in point was one of advanced pyelonephritis and stone. One point regarding pyelonephritis is of importance. Unless the condition is fairly advanced, the expected blunting of terminal calices is not regularly found, in my opinion, and the retrograde pyelogram shows a normal pelvic outline or one of diminished caliber due to edema or hilar infiltration.

The narrowing may be so general as to disguise itself or sufficiently irregular to show bizarre outlines, as so well demonstrated by means of intravenous urography with the Jarre camera and serial exposures.

I have never seen an unmixed renal tumor with peripheral calcification or marked (if any) mobility or rotation on the long axis of its matrix, so therefore I could not agree with Dr. Shiflett's diagnosis in his Case 3 in its entirety. On the other hand, I do agree that the kidney was not a true congenital polycystic kidney but rather an acquired type of multiple cystic kidney. I hope he will be able to follow the case long enough to prove this point.

The practice of lateral pyelography has borne much fruit in my hands before Dr. Mertz' presentation and is a procedure of very great general value. Dr. Shiflett has noted many valuable aspects of this additional step and I think it should be a part of our regular routine. Lateral pyelograms will give all the necessary information relative to renal ptosis, according to Dr. Howard, of Seattle.

The coccal infections of the kidney and perinephric space have elicited great interest of late and it is well that Dr. Shiflett has pointed out the shortcomings of urographic methods in arriving at a diagnosis in some cases. Much of the information obtained, however, is of negative value.

Finally, it was a real treat to have the explanation of mid-vesically placed ureteral stones. The urologist is wary of a report stating that the stone has moved into the bladder when his patient is still showing definite clinical evidence of ureteral obstruction.

There are a few clinical entities not mentioned in the paper, having significant roentgenographic aspects. I should like to mention leukoplakia of the renal pelvis and the mycotic infections. Actinomycosis especially may so closely simulate either renal tumor or renal tuberculosis as to make differentiation difficult. Extra-renal, retroperitoneal tumors likewise may produce so much displacement of one or both kidneys as to be very difficult of satisfactory interpretation, especially if there is secondary renal infection.

DR. E. L. SHIFLETT (closing): I wish to express my thanks to Dr. Cumming for his discussion.

I am very sorry that my paper was a little too long to be read in its entirety in the time allotted, and particularly in reference to the great error that can be made in following the progress of a stone down the ureter.

We are frequently called upon to check the position of a ureteral stone for the urologist, and if he has confidence in our opinion, he will usually be guided considerably by it. This confidence comes only through close association with an individual or a group, and by working wholeheartedly with them and in the proper spirit.

We had a case, an Alaskan missionary, who developed a stone in the right kidney. The first time we observed the stone, it was at the junction of the upper and middle thirds of the ureter. He was admitted to the hospital and observed. We checked the position of the stone practically every day, and it descended until it reached the lower end of the ureter, where it stayed.

The morning the patient was scheduled for surgery, he was sent to us for examination. To be doubly sure that we would not make a mistake, we made a stereoscopic examination of the man's bladder and ureteral orifices. When I looked at this stone I was sure it had passed to the

bladder because it appeared to be lying anteriorly, and almost in a vertical plane with the posterior surface of the pubis. A diagnosis of stone having passed to the bladder was made.

Surgery was canceled for the morning, but the patient continued to have his symptoms; straining of the urine failed to recover the stone, and we did not know just what was wrong. We had a consultation, and there was considerable discussion as to the location of the stone. One of the urologists was so confident it was in the bladder that he wanted to bet a thousand dollars it was there; he stated that it couldn't possibly be in the ureter.

Dr. Mertz, having seen similar cases, said, "I will tell you what has happened. This man has marked edema at the uretero-vesical orifice which has caused marked pouting forward, and this has moved the ureteral orifice anteriorly, but the stone is still in the ureter." He cystoscoped the man and confirmed his clinical impression.

This case does illustrate what I wanted to point out—the difficulty sometimes encountered in diagnosing the very common urologic lesions when they give unusual roentgen manifestations. We have a great number of examinations from which to chose the one most applicable to the lesion we are trying to diagnose. I do not believe we can do good urology by simply following a routine roentgen procedure.

A 1936 SURVEY OF THE BIOLOGICAL EFFECTS OF X-RADIATION[1]

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THE undoubted value of x-rays as a research tool to the biologist in the field of genetics has been convincingly demonstrated in the past few years by the work of Professor H. J. Müller, of Texas, and a very considerable number of other workers. Much less well known are the great possibilities of cell studies depending upon an increasingly quantitative evaluation of characteristic radiosensitiveness, which may well become the most powerful method of pathologic diagnosis. Uncertainty remains as to fundamental differences between normal and pathologic tissues, and the mechanism involved in radiobiology and therapy of cancer cells. It has seemed desirable, therefore, to summarize briefly our present knowledge of the biologic effects of x-radiation, under the following heads:

I. Bactericidal and General Lethal Effects.
II. Biologic Dosimeters.
III. Effects on the Hereditary Material.
IV. Effects on Normal Cells.
V. The Radiosensitiveness of Cells.
VI. Recovery and the Time Factor.
VII. X-ray Effects on Human Tissues.
VIII. The Stimulating Effect of X-rays.
IX. Photochemical Experiments with a Possible Bearing on Biologic Effects.
X. Medical Implications of Cell Radiosensitivity and Reactions to Radiation, with Special Reference to Cancer.
XI. A New X-ray Method of Pathologic Diagnosis.

I. Bactericidal and General Lethal Effects of X-rays.—This topic is first considered since the first suggested possible biologic application of the new rays, following announcement of their discovery by Roentgen in November, 1895, was directed to bactericidal properties. The rays were considered to be present in sunlight. Since the sun's rays were known to have bactericidal properties and were beneficial in treatment of diseases, especially tuberculosis, it was natural to turn to these rays as possibly possessing even more powerful physiologic effects. On Jan. 29, 1896, T. Glover Lyon made definite suggestions in a letter to the London Lancet. But on Feb. 17, 1896, in another letter, he announced negative results on tuberculosis and diphtheria bacteria. This was the beginning of experiments on every type of organism in laboratories throughout the world, an account of which would occupy an entire volume. Some of the experiments were highly favorable, but the great majority were negative; positive bactericidal effects in one laboratory were entirely disproved in another. Thus began the great science of x-ray therapy under these highly unfavorable conditions. While it became nearly universally agreed that bacterial cultures were nearly inert except to relatively enormous doses of radiation, the tremendous effect of rays on living tissue also became apparent. In 1902, Pusey and Caldwell stated in their book the following: "The fact that organisms in living tissues can be destroyed by exposure to x-rays, while the same organisms in inert cultures are uninfluenced by x-ray exposure, proves positively that it is not the influence of the x-ray *per se* that

[1] A revised form of a paper presented in July, 1934, in a Symposium on Growth, at the Biological Laboratory, Cold Spring Harbor, Long Island, and published in the Symposia on Quantitative Biology, 1934, **2**, 249. This opportunity is taken to express the sense of deep personal loss in the untimely death on Jan. 7, 1936, of the Director, Dr. Reginald E. Harris, who suggested the original preparation of this survey.

Comments, criticisms, and reports of new observations will be greatly appreciated, so that the best possible chapter on this subject may appear in a forthcoming new edition of "Applied X-rays."

causes destruction, but that the tissues themselves doubtless under the conditions of activity excited by the x-rays play the important rôle in the germicidal process."

It would be profitless to enumerate the long series of experiments on bacterial cultures. The reputable results agree in showing logarithmic death rates for very large dosages, as exemplified in the results by the writer on *B. coli* and *Erythrobacillus prodigiosus*.

The irradiation was effected with a tungsten target tube, using a potential of 65 kilovolts and a current of from three to four milliamperes. At certain time intervals, test tubes were removed and dilutions plated out to determine the total counts. The analytical results are summarized in Table I. The rate of sterilization may be noted when the bacterial count is plotted logarithmically against the time of irradiation.

The following conclusions may be derived from these data:

(1) X-rays act like sterilizing agents upon cultures of *B. coli* and *Erythrobacillus prodigiosus*, in that the curves are characteristic sterilization or death-rate curves, showing that the total counts decrease logarithmically with time.

(2) In this experiment *B. coli* did not show variation or mutation when it was treated with x-rays.

(3) With increasing irradiation, *Erythrobacillus prodigiosus* showed a tendency toward lack of ability to produce its characteristic red pigment. By allowing the organism to grow on the plate for a period of five days, the greater portion of the colonies produced their pigment. If a transfer of a white colony is made to an agar slant, the characteristic pigment is produced in twelve hours. In only one case was it necessary to make a second transfer in order to bring about the development of the pigment. The above is another example of the variation tendency of *Erythrobacillus prodigiosus*.

TABLE I.—SUMMARY OF ANALYTICAL RESULTS

B. coli Data

Sample No.	Time of Irradiation in Minutes	Total Count per c.c. (24 hrs.—37° C.)	Remarks
1	0	70,000	Single colonies were picked from plate of sample No. 6 and morphology and cultural characteristics were examined. All tests were characteristic of the original.
2	5	70,000	
3	15	17,000	
4	30	9,000	
5	45	1,700	
6	60	10	
7	90	0	

Erythrobacillus prodigiosus Data

		Observations of Glucose-agar Plates			
		2nd day	3rd day		5th day
Sample No.	Time of Irradiation in Minutes	Total Count per c.c. 20° C.	Pigment	Pigment of Colonies	Pigment of Colonies
1	0	800,000	red	red	....
2	5	600,000	red	red	....
3	15	480,000	red	red	....
4	30	400,000	red	red	....
5	45	300,000	red	red	....
6	60	45,000	80% white*	50% white	90% red
			20% red*	50% red	10% white
7	90	400	100% white	80% white	60% red, 40% white
8	120	0	....	....	....

* All white colonies that were fished from the plates (12 in number) and streaked on agar slants produced luxuriant red pigmented growth at 20° C. in 24 hours, with the exception of one colony fished from sample No. 7 which failed to give red pigment until it was transferred to a second agar slant.

Cultures of simple organisms have been used frequently to discover the effects of various x-ray wave lengths, generally indicating as in all other cases a biologic effect independent of wave length under comparable conditions of energy absorption. Wyckoff (1) found that rays kill *B. coli* and *B. ærtryke* in linearly exponential fashion. He considers that death results by the absorption of a single x-ray quantum of energy. Since only 1 in 20 of the absorbed quanta kills, the sensitive cell constituents, the destruction of which leads to cell death, must have a volume which is less than 0.06 of the bacterium itself. Closely related are experiments with yeast. Wyckoff and Luyet (2) find that unlike bacteria, yeasts can be injured, without being killed outright. Injury is followed by an extraordinarily large number of two-celled colonies, which on prolonged incubation ultimately die without further budding.

Of course, the final absolutely general effect of x-rays on living organisms is a lethal one.

II. Biological Dosimeters.—The quantity of radiation required for death is so definite for each particular type of cell that a lethal count serves as a quantitative dosimeter of the radiation. Five years ago, Wood showed that for *Drosophila* eggs 50 per cent are killed by 190 r and 90 per cent by 500 r.

The extended work by Packard (3) has confirmed these values, and also the fact that these eggs give probably the best results of any biologic material when used with a definite technic, such that generally average ages of the eggs are involved. For the radiosensitivity increases rapidly during early stages of nuclear division, attaining a maximum when the embryo shows the first sign of differentiation and falling abruptly thereafter. The 50 per cent survival dose for eggs 90 minutes old is 163 r; for those 330 minutes, it is 1,044 r. Equal doses of x-rays generated at potentials from 12 to 700 kv. kill equal proportions of the eggs. This biologic test object is also suitable for γ-ray dosage; Packard has found that the number of equivalent or biologic roentgens per mc.-hr. is 5.00 r/mc.-hr. at 1 cm. distance and with 0.5 mm. platinum filter.

TABLE II.—EGGS. 180,000 KV.P.; 5 MA.; $^1/_4$ MM. CU PLUS 1 MM. AL; 50 CM. DIST., EFFECTIVE Å.U. = 0.22

Time Rayed	r Units	No. of Eggs	No. Inf.	Dead Germs	No. of Chicks
2 min. 34 sec.	38.50	10	2	5	3
5 min. 9 sec.	77.25	9	2	3	4
7 min. 43 sec.	115.75	10	1	5	4
10 min. 18 sec.	154.50	10	0	3	7
12 min. 52 sec.	193.00	10	0	7	3
15 min. 27 sec.	231.75	10	3	4	3
18 min. 1 sec.	270.25	10	0	6	4
20 min. 36 sec.	309.00	10	0	8	2
23 min. 10 sec.	347.50	8	1	4	3
25 min. 45 sec.	386.25	7	0	6	1
28 min. 19 sec.	424.75	6	1	4	1
36 min. 3 sec.	540.75	7	1	4	1
43 min. 46 sec.	656.50	7	0	5	1
51 min. 30 sec.	772.50	7	0	7	0
59 min. 13 sec.	888.25	7	0	7	0
66 min. 57 sec.	1,004.25	7	1	6	0
77 min. 15 sec.	1,158.75	8	1	7	0

The explanation of the fact that just half of a given number of eggs are killed by 190 r or that the survival curve in general is S-shaped, lies either in the fact that eggs collected over a two-hour period have a distribution of ages and sensitiveness, giving on the average with a fixed routine this constant effect, or another hypothesis depends on the assumption of a differential portion in each cell, more sensitive than the rest, the destruction of which by one or more x-ray quanta will cause death. Therefore, the survival curve is determined by the size of the sensitive spot and the number of quanta required to kill it. This hypothesis requires the existence of this spot being equally sensitive at all times, whereas the sensitiveness is known to change rapidly during mitosis. This method involves incubating the irradiated eggs and counting the survivors. Direct and immediate observation upon lethal effects of x-rays can be made on the hearts of the transparent *Daphnia magna*, which stop beating upon death (4). As a further indication of the lethal effects, Table II shows the results of experiments in the writer's laboratory on hens' eggs. Other biologic dosimeters which have been used are the familiar erythema reaction, the growth of

seedlings, the hatching of *Ascaris* eggs, and colony development of bacteria.

III. Effect of X-rays on Hereditary Material.—The experiments with bacteria have shown that the only observable biologic effect is death, while in yeast it is indicated that reproductive processes may be greatly affected by irradiation energies far smaller than required for the death of the organism. This brings us to a brief discussion of x-rays in the science of genetics, already recognized by all biologists. In 1903, Albers-Schönberg discovered the sterilizing effect of x-rays. From that day to this, the controversy has raged as to what effect may have been suffered by those cells irradiated but not sterilized. The controversy has taken the principal direction of whether or not sterilization of human beings by x-rays is safe, or whether cells which have suffered changes in the hereditary material may not produce abnormal young when reproductive powers are re-established. Müller, outstanding authority in the field, has the following to say about x-ray methods in the hands of the geneticist. Speaking of the gene he says:

"It is evident that one chief method of attack in this new type of physiological analysis, a method which must be of high eventual importance to pathology, as well as to physiology and embryology, would be the alternation or the excision of individual genes, one at a time, out of these thousands of genes, followed by intensive embryological, physiological, and physicochemical study of the effects thereby produced on the organism. In other words, if we had the ability to change individual genes, we should have, in effect, a scalpel or an injecting needle of ultra-microscopic nicety, wherewith to conduct the most refined kind of vivisection or biochemical experiments on our experimental animals, not experiments in which gross parts are removed, injected or otherwise changed, but experiments in which the finest, most fundamental elements of the body fabric are separately attacked. Changes in the genes, which have arisen spontaneously and are already at hand, can of course be used in such a study, but many of the most instructive types of these have already been largely weeded out by a process of natural dying off, in other words, natural selection, before we can find the individuals containing them, while many of those still existing lie scattered far apart and concealed. Moreover, in nature gene changes arise very rarely. Thus, the advantage which we would have if we were able to manufacture our own supply of them is evident. But apart from the action of radiation, no generally effective means of artificially producing such gene changes, or gene mutations, as they are called, has as yet been satisfactorily demonstrated, that is, demonstrated in such a way that most specialists in heredity are willing to agree that the case is proved. Hence, the question of the production of changes in the hereditary material by means of roentgen or radium rays becomes all the more urgent" (5).

C. R. Bardeen, in 1906, first found that the ova of a toad fertilized by spermatozoa exposed to x-rays developed abnormally, and he concluded that the action of the rays must be on those unknown substances in the nucleus, or the protoplasm most intimately associated with the nucleus which control the morphogenetic activities of the cell. Thus Bardeen was lacking only the concept of the chromosome. Most of the work between 1905 and 1925 has limited value largely because a great preponderance of new gene mutations probably escaped attention, since almost without exception these are recessive and cannot be detected until the third generation. Starting with the work of Koeneke, in 1905, on lilies, visible alterations on chromosomes of irradiated cells were recorded. Mohr, in 1919, reported that irradiation of locusts often caused a chromosome to enter the wrong cell (non-disjunction). It has remained for the work of Müller and associates, especially on *Drosophila*, to found a technic and an entire radiogenetics. Briefly outlined, some of these facts are as follows:

(1) There are two kinds of alterations in the structure of hereditary material: (*a*) intrachromosomal or change in linear arrangement of genes within the chromonema, which forms the basis of the chromosome, by simple loss, simple translocation, mutual translocation, inversion, deletion and complex combinations of these; (*b*) a change in the composition of the genes

themselves. Changes of both kinds can be produced in abundance in *Drosophila*, 150 or more times as abundant as in the controls. Over half of the sperm remaining capable of taking part in fertilization and development are genetically affected. Mutated genes and changed chromosomes are inherited in accordance with usual Mendelian and chromosomal properties.

(2) Visible mutations extend to bodily form and size, colorations, conformation of individual organs, fertility, reaction to light and gravity and heat tolerance. Morphologic changes are often obscure and secondary to physiologic ones; at least 80 per cent are lethal and most of the rest detrimental. Changes are distinctly random, hence a very few may happen to be beneficial. For example, recent experiments by the General Electric Company on irradiation of bulbs of the lily *Lilium reginum* have led to a species which will not shed pollen; hence, discoloration of the flower and early wilting are prevented. Here a distinctly unfavorable mutation from the standpoint of propagation is very favorable commercially to the florist. The chromosome changes usually are more detrimental than gene mutations.

(3) The mutations and changes are produced by x-rays in germ cells of all types, spermatozoa, whether irradiated in the testis or after reception by the female, spermatogonia, mature eggs, oöcytes, and oögonia. If an embryo is irradiated, the adult may show a patch of mutated tissue, in the midst of normal tissue, derived from a single embryonic cell. A great variety of plants and animals show results confirming those on *Drosophila*, including wasps and other insects, barley, tobacco, jimson weed, maize, wheat, cotton, primroses, snapdragons, petunias, mice, frogs, etc. Snell, in 1933, demonstrated that a quarter of the functional sperm of mice, after irradiation with only 400 roentgens, carries chromosomal translocations to be detected through inheritable infertility in the first and later generations; also, that over 50 per cent of embryos die *in utero* when one parent comes from an affected line, and that morphologic changes occur, such as misshaped spleens and dwarfism. The implications of such results in terms of human beings are greatly stressed by Müller.

(4) In a recent piece of work on the effects of x-rays on the developing chick (6), dosages of 40 to 600 r and at egg ages ranging from 19 to 243 hours were given. The following interesting results were noted:

(1) In 45 per cent there was no further development after irradiation.
(2) In 24 per cent chicks died in the shell at full development.
(3) In 11.9 per cent chicks died after developing 15 ± days.
(4) In 9 per cent the legs of the chicks were paralyzed.
(5) In 6 per cent the legs and feet were deformed, ranging from distortion of toes to a total absence of one or both feet.
(6) In 1.4 per cent, there was a hydrocephalic head deformity.
(7) In 1 per cent, there were miscellaneous deformities (brain, beak, wing, etc.).

(5) Chemical and molecular structural changes in reproductive cells still escape us and await the joint efforts of chemists, physicists and biologists.

IV. The Effects of X-rays on Normal Cells.—The very first step in a long series of events attendant upon irradiation of cells is a purely physical one—the collision of radiation quanta with electrons in the atoms and molecules of the chemical substance of a cell, and the release of these photo-electrons, leaving ionized atoms, or the raising of electrons to higher energy levels, leaving an activated atom or molecule. The ionized or activated atoms have properties no longer to be associated with the original unirradiated atom. The protoplasm and the protein molecules are of necessity changed, and are usually broken down to other substances ordinarily simpler. These degradation products or molecular fragments must be as foreign to the cell in its normal structure and function as though we had introduced materials from the outside by some

micro-inoculation. Under these circumstances the morphology and physiology of the cell must change in such a way that at least the gross features can be recognized by the histologist and physiologist.

(1) All changes follow a latent period after irradiation, which may be very short if our methods of detection are sufficiently sensitive for minute structural, chemical, and biologic changes, but may be very long if we judge only by death or a gross phenomenon such as skin erythema.

(2) It has long been known that exposure of young organisms to sufficiently large doses of short wave length radiation inhibits subsequent growth and development. That there is a marked effect upon normal cells is unquestioned. But the *possible seat of attack of the radiation* (and the high speed photo-electrons liberated by it) is a far more difficult problem. Much research in the past few years has attempted to find this mechanism but the answer is as yet incomplete. In studies with plants such as wheat and oat seedlings, Skoog (7) and others proposed, in 1934, that inhibition of growth is attributable to the destruction of a growth-promoting substance, or plant hormone—auxin—which is produced in twice as great amount in light-grown seedlings as compared with the dark-grown. Chesley (8) has found this hypothesis supported experimentally in some but not in all respects. Considerably less is known about roentgen-ray effects on growth-promoting hormones in animal or human tissues.

(3) Translucent protoplasm first becomes turbid and then granular, indicating that the state of aggregation of protein molecules completely changes, because of disturbance in distribution of electric charges making for coagulation. The same effect may be produced *in vitro* by chemical effects and unfavorable media. Obviously, since irradiated cells are known to return to normal unless subjected to unbearable dosages, the process can be reversible. One theory due to Dessauer, and held by a number of radiologists, was coagulation by minute points of radiation heat generated in the tissue from the conversion of kinetic energy of the photo-electrons.

(4) Many workers have demonstrated the shrinking and clumping of chromosomes, moving irregularly to daughter cells, some lagging behind, and some entering the wrong cell. In more advanced stages, the chromatin falls to pieces and the pieces swell up and fill the cell body. After very heavy x-ray dosage, the protoplasm is vacuolized and mitochondria fragmented (see 10), and, of course, death follows.

(5) Often the marked swelling of irradiated nuclei and the ballooning of the cytoplasm are easily observed and must be interpreted as an increased capacity of these structures to absorb water through an altered cell membrane. While this sytem is too complex for complete understanding and explanation, it is logical to believe that intracellular changes produce new electrolytes by decomposition of salts, proteins, and fats, and that water is drawn in by simple osmosis.

(6) The viscosity of protoplasm is increased following irradiation.

(7) The hydrogen ion concentration is increased for the protoplasm. This effect may last for only a very short time—in the case of the skin to hours and days, for example, in lymphoid tissue. The importance of this in therapy will become readily apparent when it is considered that in cancer the blood becomes decidedly more alkaline.

(8) Cell respiration is decreased, according to a number of workers (Gottschalk and Nonnenbruch, Noller, Crabtree). On the other hand, Chesley (9) irradiated wheat seedlings and marine eggs with roentgen and γ-rays in such doses as to markedly impede growth as measured twenty-four hours after treatment, and found that oxygen consumption per gram of growing tissue is not affected. In other words, growth is inhibited before respiratory rate changes. Developmental anomalies in the marine eggs appear before the respiratory rate is altered and do not depend upon respiratory impairment.

(9) A gross effect in tissues is the actual

closing of the blood vessels and a disturbance of the vascular supply.

(10) Curtis, in work on such invertebrates as cœlenterates, planarians, and annelids, and Butler, with the vertebrate *Amblystoma*, have shown that the normal ability of these species to regenerate lost parts is completely destroyed when subjected to x-radiation. Hence, x-rays afford a method of studying experimentally the differentiation process in regeneration as compared with differentiation in normal embryonic development.

(11) The rate of cell division is changed. It is a universal finding that cells which are in mitosis at the time of exposure to x-rays complete the division even with inordinately high dosages up to nearly 100,000 roentgens, while other cells are prevented from undergoing mitosis. They lose motility and then may literally explode. After a while they may regain apparent normal behavior, but occasionally after a few further divisions may die suddenly. In recent work in the writer's laboratory on salamander larvæ, the depressing effect of roentgen rays on mitotic division was clearly demonstrated. A study of the neural tube of the larvæ, given sublethal dosages of 400 and 800 r, reveals as the initial effect a disappearance of mitotic figures from the germinal cells of the ependymal layer; a period of pseudo-recovery, lasting four or five hours during which mitotic activity reappears; a period of severe degenerative changes, occurring mainly among cells in the resting stage, and a period of remarkable regeneration which leads to evident recovery. Irradiation causes mitochondria to enspherulate at a dosage of 1,200 r given at a single exposure. The Golgi substance gives no specific reaction and is regarded most resistant. From this work the cell components in the order of their sensitiveness to irradiation are found to be as follows: nucleus, mitochondria, and Golgi substance.

(12) We have thus enumerated the best known morphologic, chemical, and physiologic changes following irradiation. The question naturally arises as to whether these are interdependent and parallel, or merely different aspects equally important. In consideration of all facts, particularly from the chemical point of view, we would agree that there are primary and secondary biologic effects. The primary effects are as follows:

(*a*) Increase in hydrogen ion concentration of protoplasm which may account for coagulation.

(*b*) Increase in cell membrane permeability.

(*c*) Increase in viscosity, a consequence of hydrogen ion concentration change.

(*d*) Possibly a change in respiratory rates. The actual changes in form observed for irradiated cells are a consequence of these effects.

V. The Radiosensitiveness of Cells.—We come now to a subject which in the opinion of the writer is the most important and significant in the entire field of radiobiology. It is the basis of one of the most important applications of radiation in biology, of identification of cells, of medical diagnosis, and of x-ray therapy. Prominent among a large group of experimenters who have demonstrated characteristic radiosensitiveness of cells is Dr. A. U. Desjardins, of the Mayo Clinic. The following classification is based upon his work. In 1904, Bérgonié and Tribondeau announced the principle that young or immature cells are more radiosensitive than old or adult cells. This was the beginning of a vast number of observations, ranging from effects of irradiating a pregnant uterus, to single cells. To interpret the principle to the end that sensitiveness varies directly with the reproductive capacity of the cell, and inversely with the degree of differentiation, is perhaps not so satisfactory except in a general sense, since there are notable exceptions, as Packard has shown.

"Indubitable as is the relation of the age of cells to radiosensitiveness, analysis of the experiments made to test the susceptibility of different organs and tissues brings out the even more important fact that each variety of cell in the body has a specific sensitiveness, or rather a

specific range of sensitiveness, to radiation. This is not intended to imply that all cells of one kind, such as lymphocytes or squamous epithelial cells, react in precisely the same way to a given dose of rays. A certain measure of variation in reaction must necessarily occur, because different cells of the same kind are struck by the rays while in different stages of metabolism. Other still unknown factors also may play a part. However, if allowance be made for such variation, and if reaction time be taken as a criterion, the specific sensitiveness of each kind of cell looms up as the dominant single fact of radiology and deserves to be recognized as a law. And yet, if we may judge by present-day writings, the existence of such a law and of its medical and biologic implications is not at all realized. For years much has been made of the dogma that pathologic cells are more radiosensitive than normal cells of the same kind, but, as Lazarus-Barlow and others have shown, the foundation on which this dogma rests is tenuous and insecure. The physiologic condition of cells undoubtedly has some influence on their sensitiveness, but such influence is small as compared with the specific natural susceptibility of each variety of cell. Although the factors responsible for such specificity have not yet been determined, the sensitiveness peculiar to each kind of cell appears to be related chiefly to the natural life cycle. Thus the lymphocytes, the metabolic cycle of which among human cells is the shortest, are also the most radiosensitive, and the nerve cells, the life cycle of which is the longest, are also the most resistant to irradiation. But to this question as to many others the final answer has not been given."

When a living tissue or organ is exposed to roentgen rays or radium, a more or less important proportion of cells may subsequently exhibit temporary inhibition of metabolic activity or complete and permanent disintegration, or may not show any deleterious effect. Moreover, if the time intervening between irradiation and perceptible reaction is taken as a criterion, it will be found that certain species of cells react more rapidly than others to a given dose, or the degree of reaction to the same dose is greater for some kinds of cells than for others. Similarly, as already mentioned, the different components of the same cell vary in sensitiveness. According to our present knowledge cells may be classified, according to their radiosensitiveness, in the following order:

Lymphoid cells (lymphocytes).

Polymorphonuclear and eosinophile leukocytes.

Epithelial cells:

(1) basal epithelium of certain secretory glands, especially the salivary glands.
(2) basal epithelium (spermatogonial cells) of the testis and follicular epithelium of the ovary.
(3) basal epithelium of the skin, mucous membranes, and of certain organs, such as the stomach and small intestine.
(4) alveolar epithelium of the lungs and epithelium of the bile ducts (liver).
(5) epithelium of tubules of the kidneys.

Endothelial cells of blood vessels, pleura, and peritoneum.

Connective tissue cells.

Muscle cells.

Bone cells.

Nerve cells.

Although the difference in susceptibility between the most sensitive and the least sensitive varieties of cells is considerable, none of the cells is wholly invulnerable to radiation; all cells, whatever their variety, may be destroyed or injured if exposed to a sufficiently large dose of rays, especially if doses within the therapeutic range are disregarded (10).

VI. Recovery and the Time Factor.—Closely connected with sensitiveness is the power of recovery, obviously a phenomenon of enormous importance in therapy. The protozoan paramecium can recover after x-ray dosages as high as 60,000 roentgens. Numerous experiments have demonstrated that the best recovery is associated with the *low* reproductive and metabolic rate of the cells. Hence, susceptibility and recuperative powers are inversely proportional. It is not surprising that the intensity of the roentgen-ray beam has a determining effect on the biologic change. Weak dosages over a long time are decidedly less

effective than intense radiation delivered in a short time. Holthusen found that with intensities varying from 500 r/minute to 0.5 r/minute, erythema resulted with 500 r for the maximum intensity; 1,200 r for a beam of 5 r/minute for 240 minutes; and 2,000 r for an intensity of 0.5 r/minute. Thus a much larger total amount of radiation may actually be given underlying tissues by the fractional weak doses, without fear of skin injury or scarring, than with a single exposure to intense radiation. An injury slowly effected may be offset by definite repair processes. Packard calls attention to the analogy of a burning house. The most inflammable objects go first and then those that are more resistant. But when the house becomes a furnace of flame everything is consumed equally, regardless of whether some materials are slightly more resistant than others. So with intense doses, all tissues are injured, while with prolonged weak irradiation even small differences in susceptibility are revealed.

VII. X-ray Effects on Human Tissues (after E. A. Pohle) (11)

ACTION ON THE SKIN

According to the dose applied, it is customary to recognize four degrees of skin reaction.

First degree: no visible inflammation, but epilation following by tanning; lasts from two to four weeks and is followed by complete recovery.

Second degree: moderate erythema with definite vascular dilation (hyperemia) and a sensation of increased temperature in the treated area; epilation and pigmentation; duration from six to twelve weeks, with eventual recovery and disappearance of the tanning.

Third degree: erythema of reddish-blue color with vesiculation; epilation; loss of papillæ and of sweat and sebaceous glands; pain; duration from eight to fifteen weeks; heals with epilated thin scar and often develops telangiectasis in an atrophic scar; danger of late reaction years after the injury.

Fourth degree: deep reddish-blue erythema with vesiculation and necrosis of cutis, developing into an ulcer; extremely painful; prognosis as to complete recovery doubtful. In most cases, wide excision is the only remedy.

It is obvious, of course, that between these four degrees, there are all types of variation possible.

Numerous histologic studies of the irradiated skin have been undertaken; they lead to the conclusion that the acute roentgen reaction of the skin is essentially a degeneration of the epithelium (germinative layer), combined with inflammatory processes (interstitial edema and leukocyte infiltration). There are also changes in the capillaries, namely, dilatation and later thickening of the walls. This picture is most characteristic in the base of a typical roentgen ulcer. A similar result has been observed in a very recent histologic study on frog skin (12).

"According to the most modern viewpoint, "H" substance is liberated quite slowly from injured cells during a long period of time, causing the capillaries to dilate. Because of this gradual seepage of "H" substance, the dilation persists, and the power of contracting to the original state is lost as other cells grow and fill the stretched network forming the walls of the vessels. This action undoubtedly thickens the walls and makes them less permeable to the nutritive elements that are necessary for the growth of the tissue cells. Gradually some die while others acquire abnormal forms of growth. X-ray shock and increased nitrogen in the urine soon after irradiation might also be explained by the sudden release of "H" substance in more sensitive tissue."

Entirely different from this acute reaction are the findings in the skin of radiologists following the cumulative effect of numerous small doses of roentgen rays. Marked blood vessel changes are absent. There is hyperemia, changes in the blood distribution, and hypertrophy of the epithelium (hyperkeratosis). Hair papillæ, sweat and sebaceous glands have almost disappeared. Usually, there is edema in the corium accompanied by atrophy of the

elastic elements. Microscopically, an acute ulcer can present the same changes and that, undoubtedly, explains the tendency of both to terminate in malignant degeneration (roentgen carcinoma).

MUCOUS MEMBRANES

The mucous membranes, for instance, in the mouth and trachea, show essentially the same reaction to roentgen rays as the skin, with two exceptions. The latent time is shorter and so is the regenerative period. Mucosa covered with cylindric epithelium is much less radiosensitive than that with pavement epithelium. This can be demonstrated by irradiating the esophagus and trachea with an identical dose of roentgen rays. While no reaction can be observed in the trachea, the upper layer of the mucosa in the esophagus shows marked signs of injury.

THE BLOOD

Great practical importance must be accorded to the changes of the blood and the blood-forming organs following irradiation. Roentgen rays of short wave length in moderate and toleration doses cause a leukopenia, which is often preceded by a brief period of leukocytosis. Depending greatly upon the resistance of the individual, it takes from two to six months before the blood has completely recovered. The polymorphonuclear leukocytes seem to return to normal more slowly, and a relative lymphocytosis is, therefore, common. As a rule, the erythrocytes remain intact; it appears, however, that the red blood corpuscles of normal persons are more resistant than those of cancer patients.

BONE MARROW

In the bone marrow, the histologic changes are diagnostic within two or three hours after the exposure. There is pyknosis of the nuclei of all white blood cells beginning with the lymphocytes, while the polymorphonuclear cells are most resistant. If the dose was high enough, only the mature red blood corpuscles remain intact within the capillaries of the marrow. Regeneration is possible even after intensive exposures. The first changes in the blood of radiologists consist of a leukopenia with relative lymphocytosis.

SPLEEN AND LYMPH GLANDS

The spleen and lymph glands display identical changes, namely, an enormous pyknosis of the nuclei in the germ centers, and soon afterward, throughout the lymphatic tissue. Phagocytes take up the chromatin pieces and there are very few cells left in from twelve to fourteen hours after irradiation. Within twenty-four hours, regeneration usually begins and complete recovery takes place, provided no lethal dose has been applied.

SEX GLANDS

The sex glands, *i.e.*, testicle and ovary, are very sensitive to radiation. A relatively small dose destroys the function of the ovary, while about twice that dose produces an aspermatogenesis. In the testicle, a slow degeneration of the germinative epithelium takes place, while the interstitial cells remain intact. The mature follicles of the ovary are destroyed first, then if sufficient irradiation is given, the primary follicles also follow. If some of the latter escape injury, it is quite possible, in a sterilized woman, that menstruation will start again years after the beginning of the amenorrhea.

GLANDS OF EXTERNAL SECRETION

The glands of external secretion show changes only following the application of high doses of roentgen rays. We know that intensive deep therapy treatment over the liver region may lead to a production of lesions in the epithelium of the medium and smaller sized bile ducts. The liver cells proper seem to be more resistant. The kidney also shows degenerative changes after sufficient doses; the clinical picture may be similar to that of an acute nephritis. Irradiation of one breast in young girls has led to retarded development, while small and moderate doses in adults do not seem to interfere with the function. In animals,

no characteristic histologic changes have been seen in the breast tissue unless the animals were pregnant. If treated during the first half of the term, atrophy of the breast glands occurred; if treated during the latter half of the term, irradiation was without apparent influence. Following exposure to roentgen rays, the prostate develops a loss of glandular cells with increase of connective tissue. It is sometimes difficult to determine whether this is not a secondary change due to exposure of the testicles because irradiation of the prostate and testicles at the same time cannot be avoided. That the mucous glands in the mouth are sensitive to radiation is proved by the well known observation of dryness following treatment of that region. If this is the result of a direct effect on the glandular tissue or of an injury to the secretory nerves cannot be stated. Little is known concerning the histologic changes in the irradiated glands within the mouth.

THYMUS

The thymus, consisting mainly of lymphoid tissue, responds essentially the same as do lymph glands. No stimulating effect of small doses of roentgen rays could be detected.

SUPRARENALS

As to the radiosensitivity of the suprarenals, there are two opinions: one group of investigators believes that they are very susceptible while the other group denies this statement. The cortex is apparently more sensitive than the medulla. However, the clinical observation of patients developing the symptoms of Addison's disease after extensive irradiation of the kidney region asks for caution. Nothing is definitely known regarding the histologic changes of the thyroid after irradiation. We know, however, that the colloidal masses in colloid goiter do not respond. High doses may lead to degenerative processes in the epithelial structure of the gland (myxedema following irradiation). The anterior part of the hypophysis undergoes atrophy after irradiation, while the posterior lobe remains apparently intact. A disappearance of the colloid in the middle lobe has also been observed.

GASTRO-INTESTINAL TRACT

The gastro-intestinal tract shows histologic changes following the same dose of roentgen rays which will produce an effect on the skin. It seems, however, that irreparable ulceration occurs following the application of less roentgen energy than is necessary to produce an ulcer in the skin. Atrophy of the mucosa and of the secretory glands as the first stage of the roentgen effect is succeeded by complete necrosis. The diarrhea following exposure of the pelvis, for instance in cases of uterine carcinoma, is the first clinical manifestation of an intestinal injury.

NERVOUS SYSTEM

The cells of the nervous system in the adult organs are relatively resistant to irradiation. However, in young individuals, exposure of the brain should be approached with caution. In spite of the low sensitivity of the nerve tissue, roentgen rays sometimes have a definite analgesic effect. Relief can be brought about, therefore, in cases of neuritis. Much more sensitive are the organs of vision. According to the latest investigations, a dose of 900 r may lead to serious consequences. Besides the changes in conjunctiva, cornea, and sclera, roentgen cataracts have been reported by several clinicians. Destruction of the retina and glaucoma may be induced by excessive doses. In rabbits, the lens seem to be twice as sensitive as the cornea and conjunctiva.

HEART AND LUNGS

Of considerable clinical interest is the reaction of the heart and lungs to roentgen irradiation. We know that the embryonic heart is rather resistant to x-rays but that the heart *in situ* is much more sensitive than the isolated organ. The microscopic changes in the myocardium following intensive doses of roentgen rays are those of Zenker's necrosis and fatty degenerative

infiltration. One single application of approximately 600 r with filtered roentgen rays of short wave length over the precordium of rats and rabbits produces no definite lesions. Repeated exposures, however, lead to the before-mentioned injuries. In man, only a few cases have been reported in which the myocardium was injured following roentgen irradiation over the chest. The microscopic changes were essentially the same as seen in the experimental work reported above. High doses of filtered roentgen rays as used in deep therapy produce either temporary or permanent changes in lungs and pleura. This has been seen particularly in cases of irradiated breast tumors. The symptoms are essentially those of a pleuropneumonitis.

BONE, MUSCLE, AND CONNECTIVE TISSUE

The assumption of the low radiosensitivity of bone, muscle, and connective tissue has had to be revised during the last years. After one or more series of x-ray deep therapy, a painful induration of the irradiated muscle area has been observed, while a dose high enough to injure the connective tissue in and around a malignant growth not only defeats all therapeutic intentions but is very likely to facilitate spreading of the disease. Cartilage is more sensitive than bone, particularly in the larynx, as the observation of necrosis following treatment for carcinoma of the larynx has demonstrated. The growing bone can easily be injured, retarding or preventing further growth, while adult bone may develop true necrosis after irradiation even years following the exposure.

GENERAL SYSTEMIC EFFECT

Following the application of a sufficiently high dose of roentgen rays to the human body, the organism responds, in a certain percentage of patients, with a syndrome of symptoms usually embraced under the term "x-ray sickness." The clinical picture nearest to it is that of the well-known sea sickness. Numerous investigations have been undertaken to find the cause of this systemic reaction, and several theories have been advanced in explanation. So far, we are only sure that x-ray sickness is, in all probability, due to the flooding of the organism with the products of cell destruction following the irradiation.

Explanations advanced include lowering of sodium chloride content in blood serum (in many cases injection of 5 per cent salt solution has been effective); decrease in cholesterol content; increase in calcium and decrease in potassium; nitrogen increase in blood; changes in protein; changes in blood sugar; increase in blood coagulability; change in sedimentation rate of red blood corpuscles; release of "H" substance from injured cells, etc. A highly important and interesting recent discovery is that injection of 1 c.c. of liver extract is very effective in eliminating this effect.

VIII. Stimulating Effect of Irradiation.—For years the legend that roentgen rays or radium, under certain conditions of dosage, may increase the growth and metabolism of cells has gained wide circulation. This notion has arisen from the attempt to apply to these agents the so-called Arndt-Schultz law, according to which small doses stimulate and large doses depress cellular metabolism. Based on pharmacologic grounds, this doctrine has not been generally accepted, even by pharmacologists. The attempt to apply it to the action of roentgen rays is unwarranted, because the experimental evidence on which it is based is extremely meager and apparently invalid. A measure of acceleration is a transient phase of reaction and is invariably followed by more or less pronounced inhibition of function and cellular degeneration. Another factor in the propagation of this notion of a stimulating action of the rays has been the regression of pathologic lesions after exposure to small doses of roentgen rays. Such regression is best explained by the exceptional radiosensitiveness of certain varieties of cells. As the result of primary degeneration of certain cells a secondary and indirect stimulation may sometimes be observed. Such is the increase in connective tissue cells in certain tissues and organs after repeated ir-

radiation; the connective tissue is laid down to replace other cells which the rays have caused to undergo degeneration. Any primary or direct acceleration of cellular metabolism must be regarded as an effort of the cell to counteract or compensate for the noxious influence of the rays; in other words, it is purely a defense reaction. Continued acceleration of metabolism cannot be induced by roentgen rays or radium, which always cause degenerative changes or have no effect whatever. Irradiation of certain tissues, such as the skin, repeated over a long period of time may cause hyperplasia of the epithelium, and this in turn may lead to malignant transformation. This is not stimulation in the sense here employed, but the alteration of a normal to an aberrant function due to chronic irritation.

One phase of the problem of stimulation is found in the effect of x-rays on sensory processes. The experiments in the writer's laboratory of auditory effects in dogs are perhaps most extensive. Animals were trained to a conditioned response, associating a standard sound with an electric shock through one paw, and the acuity of hearing measured. Irradiation was made through the skull, with dosage up to 11,000 roentgens. All animals showed a transient increase in *acuity* following a latent period of 11 days of 5.5 decibels, continuing over a period of from 12 to 36 days. Even though the animal showed deleterious effects from the x-rays, such as loss of hair, skin burns, anemia, and extreme restlessness, the acuity of hearing increased. When the animal is irradiated over parts of the body entirely removed from the brain and auditory mechanism in order to ascertain whether the effect is a direct or indirect systemic one, no such increase in acuity is observed. Latest experimental data indicate the possibility that the pituitary gland is involved.

IX. Photochemical Experiments with a Possible Bearing on Biologic Effects.—A considerable number of experiments on the photochemical effects of roentgen rays on simple systems have been attempted in the effort to throw some light on observed biologic effects. However, there are very few chemical reactions in which the measurable change on irradiation is comparable with changes in the normal or abnormal cell. Greatest effects are demonstrated on photographic emulsions and in oxidation reactions, such as conversion of ferrous to ferric iron, reactions of oxalates and mercuric chloride to form CO_2 and calomel, decoloration of methylene blue, and the splitting of a few very complex molecules. Of greater direct significance biologically are the following:

(1) Formation of hydrogen peroxide when water containing dissolved oxygen is irradiated.

(2) Decomposition of water (comprising 70 per cent of cells) only in the presence of a catalyst such as iodide ion.

(3) Precipitation of proteins produced by irradiation of serum or eggwhite *in vitro;* denaturation.

(4) Change of phenol group of tyrosine in aqueous solution.

(5) Deactivation of solutions of various ferments.

(6) Oxidation of oxyhemoglobin to methemoglobin.

(7) The very important work of Fricke (13) on very dilute solutions of organic compounds in the absence of oxygen, in which a composition as measured by hydrogen, carbon dioxide, and oxygen evolution must be the result of reaction with activated water molecules rather than a direct effect of the radiation or the formation of hydrogen peroxide. The primary reaction is evidently the attachment of the oxygen of the activated water molecule to the organic molecule, with liberation of hydrogen. The conclusion is that biologic changes produced by roentgen rays may result from the partial transformation of a great number of different substances present in the cell, and very difficult to ascertain. However, the whole change observed in a mixture of substances, each of which would change if irradiated separately, may be in only one substance even in very low concentration. When a complex molecule is irradiated the change may be in one

sensitive bond only. When such a molecule with a physiologic function is irradiated, the very first change in the molecule may and does often destroy its potency.

(8) A few experiments with sensitizers or acceptors indicate great possibilities (see decomposition of water in the presence of iodide ion). An example is the splitting of sulphur (very important because of growth function of the —SH group) from thioglucose in the presence of the finely divided silver of lightly exposed and developed photographic paper. A sensitizer absorbs the radiation energy and in some manner transmits such absorbed energy to the reactants. However, much has been made of the possibilities of secondary radiation from heavy metal atoms in biologic systems, without conclusive results.

(9) The foregoing give some slight clues as to the possibilities of determining the mechanism of biologic reactions to roentgen rays. A closer correlation at this time is not possible, however.

X. Medical Implications of Cell Reactions to Radiation.—X-ray therapy is indicated when it is desirable to produce the following effects:

(*a*) *Inhibition of the growth or function of glands and cells.* Differentiated cells such as those composing glands and hair follicles, physiologically active cells, young cells, cells about to divide, lymphoid tissue, and tissue of embryonic type are all markedly radiosensitive. Skin diseases characterized by hyperactivity of the glands, hyperthyroidism, diseases which may be cured by checking ovulation, leukemia, and many other conditions are successfully treated by irradiation.

(*b*) *Solution of hyperplastic connective tissue* such as uterine fibroid (microscopic examination reveals atrophy of myomatous cells) and hyaline sclerosis of the connective tissue with dilatation of blood vessels.

(*c*) *Reduction of lichenification,* by inhibition of overgrowth of epidermal cells, and destruction of fungi.

(*d*) *Anodyne effect.* The relief of itching has been very frequently accomplished. The relief of pain, except when due to a lesion which can be cured by irradiation, is less certain, though many writers have reported an analgesic effect upon neuralgic pain.

(*e*) *Reduction of inflammation.* There is a favorable experience in the treatment of carbuncles, pneumonia in certain stages, erysipelas, etc. The rate and mode of reaction of inflammatory lesions indicate that the rays act chiefly by destroying the infiltrating lymphocytes, the exceptional sensitiveness of which has already been pointed out. Evidently these cells contain protective substances which enable them to neutralize bacterial or other toxic products, which give rise to the inflammation. When the cells are destroyed by irradiation these protective substances are liberated and become immediately available for defensive purposes.

(*f*) *Gas gangrene infections.* Unquestionably roentgen-ray treatments are a definite aid to recovery, either because hydrogen peroxide, fatal to anaërobic organisms, is formed in body fluids, or because of the release of a substance, as previously indicated, which is resistant to toxins.

(*g*) *Miscellaneous pathologic conditions.* At one time or another roentgen rays have been used in the treatment of almost every conceivable ailment. The 1935 "Year Book of Radiology" reports treatment of infection of the parotid gland, tuberculous meningitis, arthritis, poliomyelitis, whooping cough, hay fever, angina, pituitary and adrenal disturbances, vasomotor disturbances, Schüller-Christian disease, hyperinsulinism, hyperthyroidism, goiter, leukemia, etc., in addition to tumors of all varieties.

(*h*) *Destruction of benign and malignant tumors.* While it is not the purpose of this paper to enter upon a discussion of the problem of cancer, yet a few fundamental facts bearing upon the effects of irradiation are in order.

(1) First, the specific sensitiveness of different kinds of cells is here, as in the case of normal cells, the most important single factor in the treatment of neoplasms. The

susceptibility of tumors to irradiation agrees closely with the radiosensitiveness of normal cells of the same kind as those from which the tumors are derived and of which they are largely composed. Desjardins shows that the inordinate hyperplasia of lymphoid structures which characterizes Hodgkin's disease, lymphosarcoma, and lymphatic leukemia retrogresses under irradiation at the same rate as normal lymphocytes are known to be destroyed by similar exposure. "In fact, so striking is the parallel that irradiation is now being used daily as a means to distinguish such conditions when their clinical features do not permit absolute identification. In some cases, indeed, the radiotherapeutic method of diagnosis is more accurate and dependable than microscopic examination." Ewing has been able to demonstrate strikingly how various bone tumors (endothelial myeloma, benign giant-cell tumor, etc.) can be easily distinguished from other neoplasms which affect the skeleton and are noteworthy for radioresistance. Isaacs at the University of Michigan believes that nothing happens to cells during irradiation that would not have happened to them if they had lived their normal life, except that x-rays make them go through the process somewhat faster. X-rays act by hurrying the onset of old age and not by killing directly.

(2) Splendid progress is being made in the study of chemical effects. McDonald and associates at the University of Pennsylvania in the past few years have demonstrated that the cancer cell is distinguished from the normal cell by the following:

(*a*) In tumor tissue, for every 13 sugar molecules attacked, 12 are split into lactic acid and 1 is oxidized, while in normal tissue the ratio is 1:1.

(*b*) In cancer, blood plasma PH is 7.47, or 8.7 per cent more alkaline than normal.

(*c*) Blood glucose is high.

(*d*) Calcium is low.

(*e*) Potassium is high.

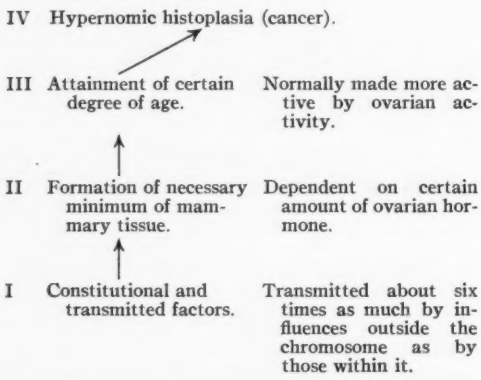
(*f*) The glycolysis activator in cancer tissue is known to be pyruvic acid.

Irradiation must in whole or part bring about conditions to restore normal energy adaptation, increase acidity (proved), decrease blood glucose, increase calcium and decrease potassium content. We do not know the mechanisms involved in these chemical transformations. Carrel has shown that malignant types of cells digest fibrin and feed upon substances or tissues which are not utilized to the same extent by normal cells. On the other hand, cancer tissue does not utilize hexose phosphates or glycogen added to the suspending medium, while most types of normal tissues do.

(3) Following is the simplest though inadequate description of cancer which is possible at the present time.

A cancer is an abnormally organized epithelial tissue which usually grows at a greater rate and to a much greater extent than the normal tissue from which it develops. C. C. Little (14) has advocated, instead of the word "cancer," the phrase "hypernomic histoplasia," meaning "tissue formation outside the law" of orderly ontogenetic processes or of growth control. The essence of histoplasia is, therefore, excess mitotic activity. Hypernomic histoplasia occurs chiefly at those periods of the development of the individual when centralized control is weakest (senility), and variation in the expression of the animal's physiologic and morphologic characteristics is greatest. Therefore, light on the origin of hypernomic histoplasia will be obtained by increased knowledge of the factors that cause and accompany this decrease in integration and effective organization of the individual. There is good evidence that the malignant transformation depends, as Hauser maintained, upon a fundamental change in the biologic characters of the cell. The latest work in cancer research indicates that there are two groups of factors which contribute to the appearance of tumors, the first histogenous, and the second irritational or stimulative factors. The two groups are related in a complex fashion. The first involves the actual nature of the tissue itself. It has long been known, for example, that different inbred strains of mice exhibit characteristic

and widely divergent degrees of tendency toward uncontrolled tissue formation. While heredity of tendency to cancer is still a moot question in spite of such splendid work as that of Maude Slye, there is a growing list of highly dependable experimental work on vigorously controlled strains. For example, Little and Murray have demonstrated that the major influence on the formation of tumors of the mammary gland in mice is transmitted to a far greater degree through the female than through the male. The situation is charted by Little as follows:


IV Hypernomic histoplasia (cancer).
III Attainment of certain degree of age.
Normally made more active by ovarian activity.
II Formation of necessary minimum of mammary tissue.
Dependent on certain amount of ovarian hormone.
I Constitutional and transmitted factors.
Transmitted about six times as much by influences outside the chromosome as by those within it.

Cellular abnormalities, including cancerous transformation, are brought about by certain physical, chemical, or biologic agents acting directly upon the cells, upon their local environment, or upon both. In most instances, a state of chronic irritation is imposed upon the tissues and certain isolated cells instead of undergoing atrophy and death as do most, persist in the altered environment. Subsequently, the isolated cells undergo progressive abnormal changes apparently of precancerous nature. Later, because the characteristic structure of a cancer cell is not clearly discernible through the microscope, the precancerous cells may be indistinguishable from truly malignant ones.

Once fully developed, the cancer cells reproduce cancer cells. The faithful transmission of the hypernomic quality from one cell generation to another for an indefinite period, meets the definition of a mutational change. As pointed out by Blair Bell, cancer cells are characterized by as avid a responsiveness to the chemotaxis of nutriment as is the trophoblast. Like the trophoblast, cancer cells possess an unusual capacity of establishing connection with a regional blood supply. Growing rapidly through the tissues, the new cells surround and penetrate the blood vessels and the lymphatics. Small masses of cancer cells becoming detached in the vessels are transported to local or distant organs. In the metastatic foci the cancer cells, just as in the primary site, grow rapidly through the tissues and readily establish a connection with the blood supply. By interfering with various organ functions, by their degeneration products, by causing hemorrhage and by undergoing secondary infection the cancerous growths cause anemia, emaciation, loss of strength, and finally the death of the individual.

According to Boveri, all differentiation of cells is due to certain alterations in one or more chromosomes. Accordingly, metaplastic changes such as the change of columnar cervical or uterine epithelium to stratified squamous type follow certain alterations of the chromosome complex of the affected cells. The change to a malignant tumor cell than may follow the direct specific action on certain chromosomes of such agents as x-rays, radium, tar, toxins, mutagens, and viruses but more frequently follows after the chronic irritation of tissues by the agents mentioned and by others such as the friction of rubbing, heat, aniline, paraffin, bacteria, and animal parasites. According to von Hansemann, the cells undergoing certain atypical mitoses, suffer a regression in differentiation, and acquire a greater capacity for multiplication. Elaborating von Hansemann's idea of anaplasia, Boveri maintained that a state of chronic irritation gives rise to a great increase in cells and favors abnormalities in cellular division. A suppression of cell division after the division of the centrosome and the nucleus followed by a tetrapolar mitosis, he claimed, may result in a malignant tumor cell. This cell, however, transmits its characteristic properties by normal

bipolar mitosis and multiple such reproductions constitute the cancer. On the other hand, Little points out that while it is true that many tumor cells have abnormal numbers of chromosomes, both in excess and less than the normal quota, such cells in comparison with those having the normal number are weak and inactive. Hence, excess mitotic activity characteristic of cancer must be largely confined to cells with normal chromosome count.

(4) *Medical treatment of cancer.* All sorts of procedures have been suggested for treating cancer other than by surgery, x-rays or radium, but as yet no chemical (including snake venom), hormonal, biologic or dietetic method has proved of the least value in control of this disease (15).

(5) *Fundamental principles of x-ray cancer therapy.* Modern therapeutic technic not only involves the radiosensitiveness of tumors, but also the relationship of the normal matrix. Tumors proceeding from radioresistant matrix tissues are likewise radioresistant in a state of complete differentiation. Osteosarcomas, fibrosarcomas and adenocarcinomas showing little sensitiveness, imitate the structure of the matrix tissue, and in all such cases, even including growths in relatively atypical manner, have the same radiobiologic quality as their matrix tissue. What in practice divides radiosensitive from radioresistant tumors is not the amount of radiation required for destruction of the tumor, but whether this amount is permissible from the standpoint of its effects on other tissues that are necessarily included in the irradiation. The radiosensitiveness of malignant tumors is not in all cases greater than that of their matrices; otherwise there would be no malignant tumor that could not be made to disappear under irradiation, and cancer would be a completely curable disease. Complete disappearance of the tumor can be achieved with certainty only when the matrix tissue can be destroyed. However, some tumors have an entirely different structure from their matrices, such as round-cell sarcomas. These are composed of cells not found in mature connective tissue. They possess a radiosensitiveness which makes possible their disappearance, whereas spindle-cell sarcoma does not differ in sensitiveness from its matrix, but in most cases therapy must involve an injury to the irradiated matrix, the reaction of which is a criterion of the reaction of tumor tissue.

This gives us a new principle of dosage, based not on the destruction of the tumor, but on disappearance of normal tissue of the matrix; the radiobiology of the normal tissue becomes the basis of radiotherapy of malignant tumors.

XI. A New X-ray Method of Pathologic Diagnosis.—The great value of the microscope in diagnosis is self-apparent. And yet it is clear that many problems of cell structure and behavior are beyond the power of any microscope to solve. For this reason other methods such as specific radiosensitiveness have been welcomed. In a paper published a few years ago (16), the x-ray diffraction method of structure research was extended to the actual structure of normal and pathologic tissues, exactly as crystals of metals, or cellulose, or fibrous proteins could be studied. A very comprehensive paper on the fine structure of living nerve as determined by greatly improved technic also has appeared very recently (17). With this "supermicroscopic" penetration down to molecules of the complex substances of cells, a fundamental molecular change from normal to abnormal was demonstrated with comparable specimens. Hence, though only the slightest beginning has been made, another great application of x-rays has been opened to biology and medicine. It is singular that x-rays will produce subtle changes in tissues and that we can use x-rays, now in a different sense, to find out what change has been wrought by the original irradiation. Beyond a doubt in some great clinic with every intellectual and experimental facility, this new method of fine structure analysis can be made to answer many of the unanswered questions of radiobiology, and by improved diagnosis lessen the scourge of cancer on the earth.

REFERENCES

(1) WYCKOFF, R. W. G.: Jour. Exper. Med., 1930, **52,** 435, 769.

(2) WYCKOFF, R. W. G., and LUYET, B. J.: RADIOLOGY, December, 1931, **17,** 1171.

(3) PACKARD, CHARLES: Am. Jour. Cancer, 1932, **16,** 1257.

IDEM: RADIOLOGY, August, 1935, **25,** 223.

(4) KERSTEN, H., and SNIDER, G. G.: RADIOLOGY, September, 1935, **25,** 285.

(5) MÜLLER, H. J.: Science of Radiology, p. 305, C. C. Thomas, Springfield, Ill., 1933.

(6) ESSENBERG, J. M.: RADIOLOGY, December, 1935, **25,** 739.

(7) SKOOG, F.: Science, 1934, **79,** 256.

(8) CHESLEY, L. C.: Jour. Cellular and Comp. Physiol., 1935, **6,** 69.

(9) IDEM: Biol. Bull., 1934, **67,** 259.

(10) DESJARDINS, A. U.: Science, 1930, **75,** 569.

(11) Largely based on a summary by E. A. Pohle, Wisc. St. Med. Jour., April, 1930.

(12) LIGHT, A. E.: RADIOLOGY, December, 1935, **25,** 734.

(13) FRICKE, H.: Symposia on Quantitative Biology, Cold Spring Harbor Biological Laboratory, 1934, **2,** 241; 1935, **3,** 55.

(14) LITTLE, C. C.: Sigma Xi Quarterly, 1935, **23,** 128.

(15) Year Book of Radiology, 1935, p. 348.

(16) CLARK, G. L., BUCHER, C. S., and LORENZ, O.: RADIOLOGY, September, 1931, **17,** 482.

(17) SCHMITT, F. O., BEAR, R. S., and CLARK, G. L.: RADIOLOGY, August, 1935, **25,** 131.

FIBROIDS AND ABNORMAL UTERINE BLEEDING

TREATED BY ROENTGEN RAY AND RADIUM. ANALYSIS OF 160 CONSECUTIVE PRIVATE PRACTICE CASES[1]

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RADIOLOGISTS have learned the possibilities of cure in uterine bleeding and fibroid pathology, and should continue to report results and discuss them. The best treatment at the least inconvenience and risk to the patient can be decided upon only after unbiased study and careful, logical approach. We are conditioned by a pattern of our experiences and I admit it is difficult to be unbiased.

I have no plan to go into the etiology or pathogenesis of fibroids and abnormal uterine bleeding. My attention, interest, and experience center around radiation treatment, and follow through to diminution of tumor size and relief of symptoms. I have been obliged to take more and more cases that border on what were formerly considered contra-indications, with unexpectedly good results and the development of confidence to repeat them.

Enough work has been done and confirmed in the last 15 years to warrant very definite conclusions as to the value of x-ray and radium in the treatment of uterine fibroid pathology.

The case material upon which this paper is based has accumulated in my private practice, since 1923. It seemed that here we had obtained our most satisfactory results, and that the cures had consistently been duplicated and the failures made notable by their absence. To prove this we have classified the cases and studied the details in a statistical tabulation. This study has been interesting and may be of value to others.

DIAGNOSIS

In physiology we are told that the endometrium responds to stimulation from the ovary, the harmones of which cause it to proliferate and secrete. Behind the ovary is another force, the anterior lobe of the pituitary gland, the harmones of which may also exert a force upon the genital tract; to complicate further, there is the possibility of thyroid influence. Therefore, perversion of menstruation is by no means of uterine origin alone. One should have a broad idea of the possibilities present before attempting a diagnosis or outlining a treatment. If no clear local pathology can be determined, then assignment of cause to ovarian dysfunction is well placed. The uterus may be only the channel of expression, and for that reason curettment of the old days so often failed. Ovarian function is most likely to go astray either at puberty or at the menopause. Most of the irradiation failures are due to mistakes in diagnosis.

No assistant can take a good history unless he has more than a limited familiarity with the subject. One case about to be treated in our district under orders from the referring physician proved to be a six months' pregnancy instead of the alleged fibroid. One must see and feel rather than take the information from someone else regarding the condition of the cervix or adnexa.

The symptoms of irregular uterine bleeding should be traced down carefully, knowing that a very large percentage of cases are associated with pregnancy and its products. Bleeding out of cycle suggests ovarian pathology; continuous bleeding lends suspicion toward the endometrium. If small in amount and frequent, one should suspect an ulcerative lesion, and here the threat and picture of beginning malignancy should be always in mind. Perfection of diagnosis, because of the seriousness of the things likely to be overlooked, should be

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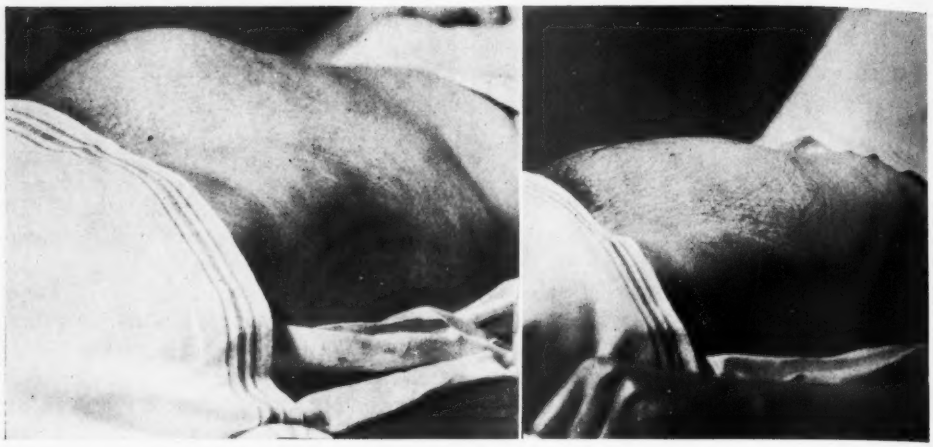

Fig. 1*A*. Fig. 1*B*.

Fig. 1-*A* (*left*). Patient (No. 12) from Group III, aged 43 years, commenced irradiation treatment on July 30, 1930. Fibroid was estimated at 7 × 7 × 8 inches; hemoglobin, 55 per cent; weight, 113 pounds; pressure symptoms. There was a history of three years' uterine bleeding. The patient was ultra-nervous. There was a history of tuberculosis of the lungs three years previously.

Fig. 1-*B* (*right*). Same patient from Group III. Contour record was taken on Oct. 18, 1930, after three months' irradiation treatment. Fibroid size was 3 × 3 × 4 inches; hemoglobin, 80 per cent; weight 130 pounds; no symptoms. Patient was examined in October, 1935, and placed in cure statistics. Hemoglobin at this time was 88 per cent; there were no signs or symptoms of fibroid.

the aim of the one who would treat these benign conditions.

Abnormal uterine bleeding is an objective evidence of real disease, and we should give it the attention it deserves. Menopausal hemorrhage is also associated with the thought of cancer, and, here again, apathy and laziness, or lack of conscience are not in order. Post-menopausal bleeding is even more significant. Pregnancy can be ruled out with an x-ray plate and an Aschheim-Zondek test. If reasonably satisfied that no maligancny need be suspected, one is warranted in starting treatment. If there is delay in the usual improvement response, one can have a biopsy report and further study.

The diagnostic curettage so much emphasized by American gynecologists is not always the possible procedure in private practice. Most patients consider this a surgical risk and refuse to submit to it.

It is agreed that a case suggesting malignancy, or complaining of urgent pressure symptoms, will not be accepted for fibroid irradiation, nor will a youthful case with moderate menorrhagia, small fibroid, and reasonable hopes of future pregnancy.

In some very large fibroids, when operation has been refused, the radiologist may be obliged to accept the case to save the patient's life.

CLASSIFICATION

A classification of patients could be made from any one of several angles, such as symptoms, cause, age, and pathology. Each could be criticized as arbitrary and faulty, necessitating too many borderline cases.

I have reviewed the records of 160 consecutive patients treated personally in my practice during the ten years from 1923 to 1933. They seem to fall into the following four groups:

I. Abnormal uterine bleeding without demonstrable fibroid, 62 cases of pre-menopausal age.

II. Abnormal uterine bleeding with small fibroid, under 3 inches in diameter, 52 cases.

III. Abnormal uterine bleeding with large fibroid over 3 inches in diameter, 35 cases.

IV. Uterine fibroids without bleeding (9 cases) of post-menopausal age.

Each group in symptoms, findings, and results of treatment are very similar, but in duration of management and requirements of irradiation are markedly different.

TABLE I.—CLASSIFICATION OF PATIENTS TREATED

Per cent	No.	Av. Time Since Tr. Two and One-half Years
38.7	62	Abnormal uterine bleeding without fibroid Group I
33.7	54	Abnormal uterine bleeding without fibroid Group II
21.8	35	Large fibroid with bleeding Group III
5.6	9	Large fibroid without bleeding Group IV
6.2	10	Under 30 years of age
66.2	106	Between 30 and 40 years of age
27.5	44	Over 40 years of age
98.7	158	White
1.2	2	Colored
6.8	11	Duration of symptoms before treatment under 6 months
47.5	76	6 months to 2 years
45.6	73	2 years to 18 years
12.5	18	Mild illness
56.2	90	Moderately severe
32.5	52	Very severe
100	160	Total no. cases treated

The pathologist thinks in terms of multiple lesions which he finds so often in post-mortem study. The radiologist is apt to find one lesion and be satisfied. His failures come chiefly because of some unsuspected co-existing pathology.

Many competent radiologists disregard the surgical suggestion that any fibroid larger than a three months' pregnancy should go to operation. This is a trite contra-indication much recognized from the surgical point of view. Hysterectomy mortality of from 1 to 4 per cent is openly admitted, while the possibility of irradiation as a treatment is often not discussed at all with the patient or relatives. We think irradiation's value very definite, having advantages of little loss of time, no danger to life, and logically well worth discussing with all concerned.

It is hard enough with bimanual examination, skin pencil, and calipers to estimate in inches the size of a fibroid, but it seems still harder to explain the size, expressed by such objects as a three months' pregnancy, an orange, or a child's head.

TABLE II.—MISCELLANEOUS OBSERVATIONS

Per cent	No.	
100	160	Number in group
15	24	Emphasizing very low hemoglobin (under 50%)
8.7	14	Emphasizing coincident thyroid pathology
10	16	Emphasizing coincident high blood pressure (over 170 sys.)
21.2	34	Showing inflammatory cervix
7.5	12	Showing abnormal adnexa
1.2	2	Showing cervical polyp
2.5	4	Abdominal scars of myomectomy
12.5	20	Associated with obesity
2.5	4	Associated with diabetes
1.2	2	Associated with leukemia
16.2	26	Associated with pain
11.2	18	Associated with tenderness
73.1	117	Abnormal bleeding at menstrual cycle
21.2	34	Associated with irregular uterine bleeding
5.6	9	Not associated with bleeding
12.5	20	Associated with inflammatory exudate and spotting
8.1	13	Complaining of pressure symptoms

Even in regard to nearness to the navel there is much to question concerning the placement of the navel or center of the fibroid. I asked surgeons and radiologists the size of a three months' pregnancy and did not receive a confident answer until I asked a pathologist. He said it was sometimes from 5 to 6 inches in diameter, but he did not know whether at three months the pregnant uterus was alike in size in all women.

Several years ago some of the surgical considerations of this subject were written and copied, and believed in as firmly as a fundamentalist believes in his Bible. Fibroids with associated inflammation were not to be irradiated, none with uncertain diagnosis, none in patients who were afraid of radium, none in cases of severe anemia, none with associated hypernervousness. Although religiously conscientious, such a dogmatic attitude could have been explained only by unfamiliarity with the use and results of irradiation; unfamiliarity might also explain the hush between the lines regarding possibilities of cure other than through surgery. There was a silence on shock, hospitalization, post-operative illness, and death rate. In recent papers, this is all being very frankly discussed.

An anemia, lower than 50 per cent hemoglobin was considered a radiation contra-

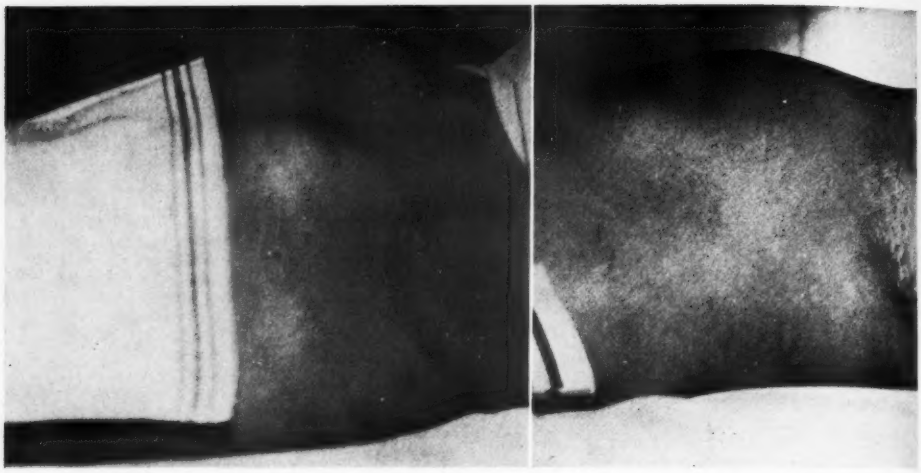

Fig. 2-*A*. Fig. 2-*B*.

Fig. 2-*A* (*left*). Patient (No. 13) from Group III, aged 46 years, commenced irradiation treatment on Aug. 5, 1932. Fibroid was estimated to be 6 × 6 × 8 inches; hemoglobin, 60 per cent; weight 127 pounds. There were pressure symptoms, hypertension, menorrhagia, and rapid pulse.

Fig. 2-*B* (*right*). Same patient from Group III. The above contour photograph was taken on Dec. 15, 1935; the patient had been symptomless for two years. Fibroid was not palpable. There was a gain in weight of 20 pounds. Hemoglobin gain, 25 points.

indication, and transfusion and operation were advised. In our menorrhagic group alone we had 11 cases with less than 40 per cent hemoglobin that made satisfactory recovery under radiation therapy. We will admit that severe anemia is a disadvantage, but not a contra-indication. Two of our cases required transfusion before irradiation.

It is the writer's opinion that in most menorrhagias, associated with severe anemias, one must gamble to some extent, but other methods of treatment should be tried before hysterectomy procedure, for that is a confession of failure and should be played only as a last card. Hysterectomy for simple menorrhagia would not be radical, but ruthless.

One gynecologist recently made the statement that if the diagnosis is not possible it is better to operate than to irradiate. This idea must be a throw forward from old exploratory days and may even yet take ten years to get out of print. As a specialty grows older, knowledge advances. The perspective of years and experience lessens gullibility and improves judgment. Barring the suspicion of cancer in menorrhagic cases, incompleteness of full diagnosis need not be a contra-indication to conservative radiation treatment. No harm will have been done and more time will have been given for the study of the problem. If progress toward recovery under radiation proves unsatisfactory, then operation, if indicated, will have simply been delayed.

Going over the closed records of a group of treatment cases suggests reasons for failures that should be avoided, and emphasizes a routine for successes that may be repeated. We all aim as best as we can to be reasonably sure of the diagnosis before accepting a case and planning treatment.

TREATMENT

Because uterine bleeding at certain periodic times is normal, patients are inclined to minimize the departures from regularity and postpone going to the doctor. This gives a longer average history of illness before treatment is commenced.

Symptoms that are liable to be self-limited make conclusions of cure inaccurate. The average long history of previous illness in our cases would suggest that they

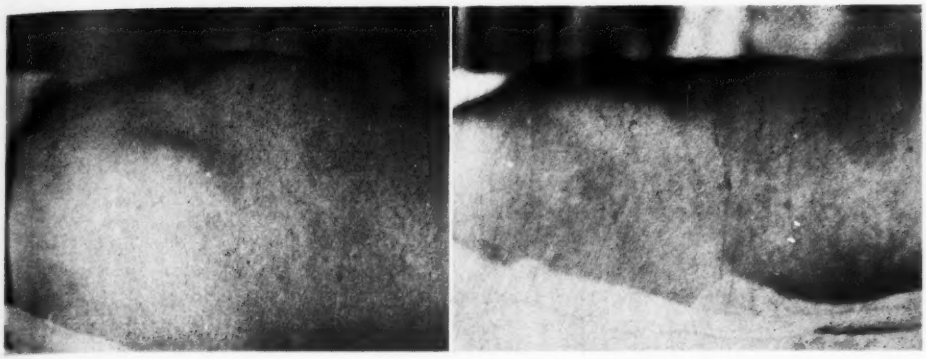

Fig. 3-*A*. Fig. 3-*B*.

Fig. 3-*A* (*left*). Patient (No. 19) from Group III, aged 48 years, commenced irradiation treatment on March 15, 1934. Fibroid was estimated to be 8 × 8 × 10 inches; there had been pressure symptoms for several years. Hemoglobin was 30 per cent; red blood count, 3,100,000; weight, 137 pounds. The patient has had menorrhagia and anemia for eleven years. Her main treatment had been liver extract, having taken 16 boxes of 75 capsules each.

Fig. 3-*B* (*right*). Same patient from Group III. The above contour photograph was taken on June 8, 1934; fibroid was one-fourth in size. The patient feels well, having gained 20 pounds, and is back on her job as housemaid. Hemoglobin was 82 per cent. The patient reported again on Oct. 10, 1935, as well.

TABLE III.—TREATMENT AVERAGES

A. No. of cases treated by roentgen radiation	104
B. No. of cases treated by radium	6
C. No. of cases treated by combination	50
Av. No. of roentgen treatments required in (*A*)	4.7
Av. duration of roentgen therapy management	3.6 mo.
Av. dose of radium required in (*B*)	900 mg.-hr.
Av. duration of radium therapy management	2 mo.
Av. No. roentgen treatment required in combination cases	4.08
Av. dose of radium required in combination cases	600 mg.-hr.
Av. duration of combined therapy management	5.5 mo.
No. cases requiring further treatment 6 mo. to 1 yr. later	9
Av. percentage gain in hemoglobin during treatment	15
Av. percentage gain in weight of patient during treatment	9 lbs.
Av. duration of illness before treatment (all groups)	1 yr. and 4 mo.
Av. duration of irradiation management	4 mo.

were not tending to be self-limited and therefore eligible for cure statistics. Some criticism may be aimed at our consideration of radium-treated cases, roentgen-ray-treated cases, and cases treated by a combination of the two in the same group. We look upon them all as irradiation cases. The tendency to divorce types of radiation therapy is unnecessary ultra-specialization, and is harmful to progress in cure results. Both methods are needed together in many of the more serious cases. Whether roentgen ray, radium, or a combination of both is used depends upon the type of patient, the equipment at hand, and the experience of the radiologist. Cure is possible by internal or external irradiation, or a combination of both.

Applying the present viewpoint to fibroid cases as they come to well-equipped clinics in the United States, England, Germany, and France (see bibliography), the percentage of cases chosen for irradiation, as compared to those operated upon, has increased in the last 10 years until the score now appears to be about from 40 to 60 per cent. Statistics of over 50,000 irradiated cases have been collected with an average cure around 90 per cent.

We all remember that in radiation therapy for toxic goiter the statement was made years ago in the vicinity of Boston, and often quoted, that; "If three x-ray treatments did not bring about improvement, the case should go to operation."

This proved to be assumption, for many cases were found to require five or more treatments before a change came toward recovery. Now again one sees in print a similar statement advising three irradiation

treatments for fibroid or menorrhagic pathology, after which, if not satisfactory, surgery should be instituted.

Quite a number of our cases were in this delayed response class and required another series, or more, in four or six months, before they were cured.

In Group III, of 34 large fibroid cases, a complete disappearance resulted in 24. Excepting two cases with complications, all the rest were completely relieved of symptoms and had only as a benign residue from one-fourth to one-sixth of the original mass, and the usual menopausal record. It was largely the good results in this supposedly contra-indicated group that encouraged this report.

There were 12 cases of fibroid between 4 and 6 inches in size; eight cases between 6 and 8 inches; 13 cases between 8 and 12 inches; three cases over 12 inches in size. No fibroid failed to lessen in size under treatment, and none grew again after treatment was discontinued.

In eight menorrhagic cases in Group I, although menstruation returned, further treatment was not required. One cannot call the return of menstruation in the productive age an unsatisfactory result if the patient is normal and symptomless. One of these eight patients passed through normal pregnancy less than a year after treatment.

TECHNIC

The voltage chosen varied from 160 to 200 kv. p.; the filtration from 0.25 to 0.5 mm. copper; the fields from 2 to 4 of 8 by 10 cm. or 12 by 17 cm. in size; the skin distance 50 cm.; the time of treatment dependent upon age and thickness of the patient, size of the fibroid, and response to previous treatment. When roentgen dosage assumed sterilization, the technic aimed to give 600 r to the mid-pelvis in three or more divided doses. The woman in reproductive prime required, as would be expected, by her virility and ovarian regeneration possibilities, greater than mid-pelvic dosage. The fat woman, as would be expected by her thickness, required greater skin dosage because of the laws of physics. Several cases in this class required long follow-up treatment, and three cases exhibited well-marked field skin reaction. Radium was used alone in a few patients who lived at a distance and could not return for the usual inspection and follow-up roentgen routine.

The work reported represents private radiologic practice. All of the cases with a few exceptions were managed outside of the hospital. It is safe to say that increased knowledge of the causes of this very common illness, a more careful diagnosis, and better tools of therapy are developing, and promise well for standardization, general acceptance, and greater percentage of cures.

SUMMARY

Diagnosis and choice of patients for irradiation, and grouping for comparison of results are discussed. Emphasis is placed on the group of large fibroid cases, and issue taken with arbitrary size contra-indications. Percentage tables are given, representing character of material, treatment averages, technic, and results. No controversy or comparison of methods and results is flaunted as against surgery or other management. The grouping admitted borderline cases. Great similarity in case findings, symptoms, and results were noted. In duration of management and irradiation dosage there was a marked difference. During the statistical study of these cases, comments have presented themselves and possible conclusions advanced with the hope of some discussion and gain in valuable therapy for the future.

TABLE IV.—TREATMENT RESULTS

%	No.	
2.5	4	Went to operation before completion of radiation
1.2	2	Treatment of no value
0.6	1	Died of carcinoma one year later
7.5	12	Improved
88.2	141	Cured (meaning relieved of symptoms, tumor, or both)
95.6	153	Satisfactory results

The average duration of irradiation management was 4 months. Satisfactory

results were obtained in 153 cases, or 95⅝ per cent.

CONCLUSIONS

(1) Our own work, as here reported, has entrenched us in the conviction of the value of irradiation in abnormal uterine bleeding and fibroid pathology.

(2) The bibliography on this subject seems to be growing less arbitrary in contra-indications to irradiation, but evidently there are still many uncomplicated fibroids being removed by surgery, which is statistically not the least risky way to recovery.

(3) We feel certain that the usual fibroid and menorrhagic patient may be safely treated and cured outside of hospital detention and surgical technic.

(4) The occasional serious and complicated case is the one in truth that humbles the radiologist and requires him to turn with gratitude to the hospital and surgeon for help in diagnosis and cure.

BIBLIOGRAPHY

ALBERTI, W.: Direct Roentgen Irradiation of Uterine Myoma, with Protection of Ovarian Function. Lijecn. vjes., 1932, **54,** 177, 178.

VON AMMON, E.: Die Erfolge der Strahlenbehandlung bei Uterusmyomen und hamorrhagischen Metropathien. Strahlentherapie, 1929, **34,** 457–500.

ASHERSON, N.: Relation of Dosage of Radium to Age in Production of Amenorrhea (in Menorrhagia). Jour. Obst. and Gynec. Brit. Emp., 1929, **36,** 778–792.

BÉCLÈRE, A.: La radiotherapie des fibromyomes de l'uterus. Semaine d. hôp. de Paris, March 15, 1928, **4,** 139–147.

BÉRARD: A propos du traitement des fibromes uterins hemorragiques par le radium. Lyon. chir., Jan.-Feb., 1933, **30,** 85–89.

BORAK, J.: Menopausal Disorders: Roentgen Therapy. Klin. Wchnschr., Oct. 15, 1929, **33,** 142–146.

IDEM: Die Rontgentherapie bei klimakterischen Beschwerden. Strahlentherapie, 1929, **33,** 142–146.

BOWING, H. H., FRICKE, R. E., and DESJARDINS, A. U.: Benign Uterine Hemorrhage: Its Treatment with Radium. Am. Jour. Roentgenol. and Rad. Ther., 1933, **29,** 497–510.

CANNON, D. J.: Physiology of Menstruation: Its Relation to Etiology and Treatment of Functional Uterine Bleedings. Jour. Obst. and Gynec. Brit. Emp., 1931, **38,** 743–772.

IDEM: Nature of Functional Uterine Bleedings. Jour. Obst. and Gynec. Brit. Emp., 1931, **38,** 565–577.

CARTER, L. J.: Further Report of X-ray Treatment of Menorrhagia of Menopause and Uterine Fibroids: Analysis of 100 Consecutive Cases. RADIOLOGY, January, 1931, **16,** 44–46.

CLELAND, F. A.: Radium Treatment of Fibroids and Fibrosis Uteri. Am. Jour. Obst. and Gynec., April, 1929, **17,** 508–516.

COLESCHI, L.: Sulla emorragiche. (Considerazioni e casistica). Arch. di. Radiol., Jan.-Feb., 1928, **4,** 130–157.

COOK, F.: Treatment of Functional Menorrhagia. Guy's Hosp. Gaz., 1932, **46,** 232–234.

CORSCADEN, J. A.: Fate of Fibromyoma of Uterus after Radiotherapy. Am. Jour. Roentgenol. and Rad. Ther., 1933, **29,** 511–515.

IDEM: Anatomic Changes Subsequent to Radiotherapeutic Treatment of Benign Uterine Conditions. Am. Jour. Obst. and Gynec., July, 1931, **22,** 74–86.

COTTE, G.: Sur le traitement des fibromes hemorragiques par les rayons. Lyon chir., Jan.-Feb., 1933, **30,** 118–122.

CRUTCHFIELD, C. R.: Practical Value of Radium in Treatment of Certain Fibroid Tumors of Uterus: Review of 286 Cases. Radiol. Rev. and Chicago Med. Rec., April, 1931, **53,** 89–92.

DANFORTH, W. C.: Treatment of Fibroids: Report of Series of 443 Cases. Am. Jour. Obst. and Gynec., September, 1934, **28,** 409–420.

DANFORTH, W. C., and GRIER, R. M.: Treatment of Fibroids, Based on Series of 233 Cases. Am. Jour. Obst. and Gynec., March, 1930, **19,** 367–373.

DONALDSON, M.: Radium Treatment of Menorrhagia and Irregular Uterine Hemorrhage. British Med. Jour., Nov. 15, 1930, **2,** 813–815.

DRIPS, D. G., and FORD, F. A.: Irradiation of Ovaries and Hypophysis in Disturbance of Menstruation. Jour. Am. Med. Assn., Nov. 3, 1928, **91,** 1358–1364.

DUHIG, J. V.: Pathology of Metrophathia Hemorrhage: Study of 112 Cases of Irregular Uterine Hemorrhage. Med. Jour. Australia, Jan. 17, 1931, **1,** 67–71.

EPPA, P.: Radium Treatment of Non-malignant Uterine Hemorrhage. Jour. Obst. and Gynec. Brit. Emp., August, 1933, **40,** 835–842.

FLUHMANN, C. F., and MORSE, D. L.: Studies on Uterine Hemorrhage: Relation of Hemorrhage to Events of Menstrual Cycle and to Pathologic Findings. Am. Jour. Obst. and Gynec., April, 1931, **21,** 455–463.

FORD, F. A.: Irradiation Therapy in Functional Ovarian Disorders. RADIOLOGY, June, 1931, **16,** 936–941.

FRANING, E. C.: Results of Treatments of Fibroid Uteri with Roentgen Ray: Series of 50 Cases. RADIOLOGY, June, 1930, **14,** 594–596.

FRANK, R. T.: Fibroids of Uterus: Their Recognition and Treatment. New York St. Jour. Med., Aug. 1, 1933, **33,** 919–924.

FRIEDMAN, L. J.: Radiation Therapy for Benign Uterine Hemorrhage. Am. Jour. Surg., June, 1930, **8,** 1241, 1242.

GÁL, F.: Die Strahlenbehandlung der mit entzundlichen Adnexerlrankungen komplizierten Uterusfibrome und Metropathien. Strahlentherapie, 1929, **31,** 556–562.

GAMBAROW, G.: Zur Strahlenbehandlung der Uterus-myome. Strahlentherapie, 1929, **32,** 121–130.

GAUSS, C. J.: Myoma, Choice of Treatment. Strahlentherapie, May 26, 1927, **27,** 5–26.

GOLDSTEIN, L.: Functional Uterine Hemorrhage. Internat. Clin., September, 1934, **3,** 135–158.

GOULLIOUD: A propos de la curie et de la radiotherapie dans le traitement des fibromes uterins. Lyon Chir., Jan.-Feb., 1933, **30,** 89–92.

GRAVES, W. P.: Some Observations on Etiology of Dysfunctional Uterine Bleeding. Am. Jour. Obst. and Gynec., October, 1930, **20,** 500–518.

HANKS, M. E.: Roentgen Therapy in Fibromyomas and Other Benign Gynecologic Cases: Clinical Report of 12 Years' Experience. RADIOLOGY, May, 1929, **12,** 403–408.

HERNAMAN-JOHNSON, F.: Excessive Menstrual Bleeding: Its Treatment by X-rays. Practitioner, March, 1930, **124,** 358–363.

HEWITT, H. W.: Radium and Its Usefulness in Treatment of (*a*) Malignant Disease, (*b*) Uterine Fibroids, and (*c*) Metropathic Bleeding of Unknown Origin. Jour. Michigan Med. Soc., May, 1929, **28,** 366–375.

HOLDEN, G. R.: Use of Radium in Treatment of Uterine Hemorrhage. Jour. Florida Med. Assn., February, 1930, **16,** 355–361.

HUBENY, M. J.: X-ray Treatment of Non-malignant Uterine Hemorrhage. Illinois Med. Jour., July, 1932, **62,** 50–54.

JAMES, W. D., and JAMES, A. W.: Deep Roentgen Ray, Radium Myomectomy and Hysterectomy. Jour. Am. Med. Assn., 1928, **90,** 201, 202.

KEENE, F. E., and BLOCK, F. B.: Treatment of Uterine Fibromyomas (Series 1925–1927). Am. Jour. Obst. and Gynec., June, 1929, **17,** 848–854.

KELLY, H. A.: Radium in Treatment of Menstrual Disorders. Jour. Am. Med. Assn., Sept. 12, 1931, **97,** 760–763.

KIMBROUGH, R. A., JR.: Treatment of Uterine Myomas: Review of 500 Cases. N. Y. St. Jour. Med., Jan. 1, 1934, **34,** 18–22.

LABHARDT, A.: Die Therapie der Uterusmyome auf Grund der Erfahrungen an 1000 Myomoperationen. Schweiz. med. Wchnschr., April 26, 1930, **60,** 381–384.

LANDHAM, J. W.: Radiotherapy in Treatment of Uterine Fibromyomas. Jour. Florida Med. Assn., October, 1930, **17,** 171–174.

LAWS, G. M.: Results of X-ray Therapy in Myoma and Other Non-malignant Lesions of Uterus. Am. Jour. Obst. and Gynec., June, 1929, **17,** 855–860.

LINDENBERG, F.: Uterine Fibroids: Fundamentals in Application of Roentgen Rays. California and West. Med., August, 1929, **31,** 93–98.

LYNCH, F. W.: Uterine Fibromyoma: Review of 683 Cases. Jour. Am. Med. Assn., Jan. 18, 1930, **94,** 156–162.

MACRAE, J. D., JR.: Radiation Treatment of Uterine Fibroids and Other Non-malignant Uterine Hemorrhage. South. Med. and Surg., June, 1930, **92,** 413–419.

MARTIN, C. L.: Uterine Hemorrhage without Demonstrable Pathology. Am. Jour. Roentgenol. and Rad. Ther., March, 1931, **25,** 349–358.

MAZER, C., and KATZ, B. R.: Diagnosis and Treatment of Functional Uterine Bleeding. South. Med. Jour., January, 1934, **27,** 13–20.

MILLER, C. J.: Radium as Temporary Hemostatic Measure in Large Uterine Fibroid. Surg. Clin. North Am., August, 1930, **10,** 725–728.

IDEM: Modern Conception and Treatment of Uterine Bleeding. Am. Jour. Obst. and Gynec., January, 1932, **23,** 24–30.

MOORE, J. T.: Choice of Treatment of Fibroids of Uterus. Southwestern Med., December, 1933, **17,** 406–413.

MORRIS, C. C.: Uterine Tumors. Harper's Med. Monograph, 1930.

MORSE, A. H.: Pathology of Abnormal Uterine Bleeding. Yale Jour. Biol. and Med., December, 1933, **6,** 89–100.

MOWBRAY, F. B.: Treatment of Fibroids. Canad. Med. Assn. Jour., March 28, 1928, **18,** 285–289.

MURPHY, J. T.: Some Observations about Treatment of Uterine Fibroids and Bleeding of Menopause. Ill. Med. Jour., January, 1933, **63,** 56–60.

MURRAY, E. F.: Radium in Treatment of Carcinoma Cervicis and Intractable Menorrhagia. British Med. Jour., Oct. 6, 1928, **2,** 609, 610.

NEILL, W., JR.: Review of Treatment of Uterine Fibroids, with Special Reference to Use of Radium. Am. Jour. Roentgenol. and Rad. Ther., April, 1929, **21,** 332–336.

NEMENOW, M.: Ueber Strahlenbehandlung der Uterusmyome. Fortschr. a. d. Geb. d. Röntgenstrahlen, March, 1929, **39,** 451–458.

NICOLLE, A.: Quelques considérations sur la technique d'irradiation des fibromes. Monde Med., Paris, Sept. 1–15, 1933, **43,** 884–887.

NORSWORTHY, O. L.: Treatment of Benign Uterine Neoplasms, with Special Reference to the Use of Radium. Am. Jour. Roentgenol. and Rad. Ther., April, 1933, **29,** 516–526.

IDEM: Treatment of Hemorrhage from Non-malignant Uterus. Am. Jour. Roentgenol. and Rad. Ther., April, 1929, **21,** 336–344.

NOVAK, EMIL: Uterine Bleeding of Middle Life. Jour. Tenn. Med. Assn., March, 1931, **24,** 81–87.

IDEM: Delaware St. Med. Jour., April, 1931, **3,** 65–70.

IDEM: Ovarian Dysfunction and Uterine Cancer as Causes of Menopausal Bleeding, with Remarks on Treatment. Med. Jour. and Rec., Nov. 6, 1929, **130,** 481–484.

IDEM: Functional Disorders of Menstruation, with Remarks on Organotherapy. Jour. Am. Med. Assn., Oct. 25, 1930, **95,** 1221–1227.

OLMSTED, A. O.: Uterine Fibroids and Radium: Résumé of 370 Cases in Private Practice. Wisc. Med. Jour., May, 1934, **33,** 340–345.

OVERGAARD, A. P.: Deep X-ray Therapy for Fibroids and Uterine Hemorrhage. Nebraska Med. Jour., November, 1933, **18,** 417–419.

PAYNE, R. L.: Uterine Fibromyas: Review of 1,145 Cases Treated by Surgery or Radium. Radiol. Rev. and Chicago Med. Rec., September, 1932, **54,** 215–218.

PFAHLER, G. E.: Treatment of Uterine Tumors by Irradiation. Delaware St. Med. Jour., May, 1933, **5,** 107–113.

PFAHLER, G. E., and VASTINE, J. H.: Irradiation in Treatment of Fibromyoma of Uterus. Am. Jour. Roentgenol. and Rad. Ther., January, 1934, **31,** 51–59.

PHANEUF, L. E.: Radium Therapy in Uterine Hemorrhages of Benign Origin: Analysis of End-results of 150 Consecutive Personal Cases. New England Jour. Med., Aug. 16, 1934, **211,** 304–311.

POLAK, J. O.: Fifteen Years with Radium in Treatment of Fibroids, Non-malignant Bleeding and Dysmenorrhea. Jour. Obst. and Gynec. Brit. Emp., 1929, **36,** 325–334.

IDEM: Fifteen Years with Radium in Treatment of Fibroids, Non-malignant Bleeding and Dysmenorrhea. Am. Jour. Surg., May, 1929, **6,** 648–654.

PROCTER, I.: Uterine Fibroids; How Pathology Affects Treatment: Case Report. South. Med. and Surg., May, 1929, **91,** 318–322.

PUSCHEL, A.: Therapy by Roentgen Irradiation in Abdominal Field. Strahlentherapie, 1933, **46,** 346–354.

REIS, R. A., BAER, R. A., and DECOSTA, E. J.: Treatment of Uterine Fibroids. Ill. Med. Jour., November, 1934, **66,** 485.

RUBENFELD, S., and MAGGIO, R. J.: Benign Uterine Hemorrhage Treated with Radiation Therapy, with Review of 147 Cases. Am. Jour. Obst. and Gynec., August, 1933, **26,** 237–243.

SCHMITZ, H.: Treatment of Uterine Hemorrhages Due to Benign Lesions, with Radium and Roentgen Rays. Am. Jour. Obst. and Gynec., September, 1934, **28,** 355–364.

IDEM: Indications for Radiation Therapy in Benign Uterine Hemorrhage. Am. Jour. Roentgenol. and Rad. Ther., April, 1929, **21,** 327–331.

SCHNEIDER, G. H.: Die Ergebnisse der Milzbestrahlungen in Kombination mit Röntgentherapie bei gynäkologischen Erkrankungen. Monatschr. f. Geburtsh. and Gynak., October, 1928, **80,** 146–153.

SCHREINER, B. F.: Results of Irradiation Treatment of Myoma of Uterus: Based on Study of 318 Cases. RADIOLOGY, August, 1931, **17,** 265–270.

IDEM: Radium and X-ray Treatment of Myopathic

and Thrombopenic Menorrhagia. RADIOLOGY, October, 1931, **17,** 796–799.

SIMON, S.: Technik und Erfolge der Strahlenbehandlung bei unregelmassigen Genitalblutungen der Frau. Wien. klin. Wchnschr., Sept. 14, 1934, **47,** 1122, 1123.

STACY, L. J.: Treatment of Uterine Fibromyomas. RADIOLOGY, February, 1934, **22,** 212–218.

STACY, L. J., and MUSSEY, R. D.: Radium in Treatment of Menorrhagia of Adolescence and of Menopause. Am. Jour. Obst. and Gynec., April, 1929, **17,** 502–508.

STRASSMANN, P.: Myoma, Radiation Treatment. Strahlentherapie, 1927, **27,** 281–296.

THOMAS, M. A.: X-ray and Radium in Treatment of Uterine Fibromyoma and Benign Menorrhagia. Ohio St. Med. Jour., July, 1930, **26,** 599–602.

TRAUT, H. F.: Need for Conservatism in Treatment of Benign Uterine Bleeding in Women Less than Thirty-five Years of Age. N. Y. St. Jour. Med., Nov. 15, 1934, **34,** 965.

UEBEL, P.: Über die Therapie der Myoma und Hämorrhagischen Metropathien an der Würzburger Universitäts-Frauenklinik (1923 bis 1928). Strahlentherapie, 1930, **38,** 438–472.

VAUGHAN, JOHN H.: Indications for Irradiation in Intra-uterine Bleeding. RADIOLOGY, April, 1933, **20,** 310–312.

WEIGAND, H.: Ist bei der Erreichung Dauer-amenorrhöe eine Abstufung der Röntgendosis Möglich und Erwünscht? Strahlentherapie, 1928, **30,** 497–502.

WERNER, P.: Welche sichergestellten Myome sind zu bestrahlen, welche nicht? Wein. klin. Wchnschr., Dec. 22, 1927, **40,** 1611–1613.

WHITAKER, B. T.: Radiation Treatment of Small Fibroids and Menorrhagias. Jour. Iowa Med. Soc., December, 1934, **24,** 620–622.

WOOD, F. C.: Roentgen Treatment of Uterine Fibromyomas. Jour. Am. Med. Assn., March 1, 1930, **94,** 601–606.

YOUNG, J.: Menorrhagias Not Due to Uterine Disease: Causation, Clinical Features, and Treatment. British Med. Jour., Sept. 26, 1931, **2,** 556–559.

DISCUSSION[1]

DR. STEVENS (Detroit): I do not think some of these papers ought to go without a little discussion. I have been particularly interested in the report on the cases of parotitis treated by x-ray. The paper[2] has called to mind some seven cases that we have seen in Grace Hospital within the last three months. One case followed an appendectomy and ovariotomy and developed bilateral parotitis on the fourth day. When seen by me forty-eight hours later she had a well-developed, large post-pharyngeal abscess which was discharging into the ear. We gave her x-ray therapy, about 75 r to each side, with 200 kv. There followed an increase of temperature and aggravation of symptoms in the first twenty-four hours, then a very marked reduction in pain and swelling after that. We gave her another treatment on the second day and another on the third day. The swollen gland was reduced but the abscess required surgical intervention. She died on the fifth day from general septicemia, after the surgeon had operated on the post-pharyngeal abscess.

A similar case developed a post-pharyngeal abscess discharging into the ear before radiotherapy was undertaken. This patient also died from general septicemia.

One other case had no radiotherapy and died.

Four other cases were sent to me within twelve hours after onset of symptoms. All four recovered. This demonstrates the necessity for early treatment.

I think clinical evidence shows we ought to do what we can to encourage surgeons to be on the look-out for parotitis and have the cases treated radiologically as early as possible.

I was interested also in the paper on the effects of radiation of young bone.[3] I reported a case last year before this Society[4] in which I treated a baby five months of age for a nevo-carcinoma involving the upper part of the thigh and lower abdomen. Five years later there was very marked shortening not only of the femur and of the pelvic bone but also of the tibia and fibula which latter were not treated. Shortly after this osteomyelitis developed in the femur and it also looked as though there was some developing in the tibia. It would seem that not only was the growth of bone interfered with, but also its normal resistance against infection.

[1] Received too late to be included with the other discussions of papers in the Symposium on Radiation Treatment in Non-malignant Conditions (see RADIOLOGY, January, 1936, **26,** 37–68).

[2] Radium Treatment of Post-operative Parotitis, H. H. Bowing and R. E. Fricke, RADIOLOGY, January, 1936, **26,** 37.

[3] Influence of Roentgen Rays and Radium on Epiphyseal Growth of Long Bones, J. D. Bisgard and H. B. Hunt, RADIOLOGY, January, 1936, **26,** 56.

[4] RADIOLOGY, November, 1935, **25,** 538.

NOTE ON THE GUARDED FIELD X-RAY IONIZATION CHAMBER

By LAURISTON S. TAYLOR *and* GEORGE SINGER, *Washington, D. C.*

National Bureau of Standards

I. NUMBER OF GUARD WIRES

THE rather extensive adoption of this Bureau's design of an x-ray ionization chamber[1] makes it desirable to describe some minor improvements made since publishing the description; and, at the same time, to clear up some misapprehensions as to the adequacy of the particular designs of chamber which have been chosen. For instance, two cases have come to our attention in which an insufficient knowledge of the theory[2] of the guarded field chamber has led to errors of 2 or 3 per cent. On the other hand, out of a number of such chambers calibrated in this laboratory, only one has been found in error by an amount substantially greater than that fixed by the experimental tolerances.

When preparing to make an international comparison of standards in 1931, we reduced the number of guard wires from the previous selection of twelve to eight.[3] This was principally for the purpose of facilitating in the European laboratories, alignment of the chamber in the radiation beam. From the theory of the guarded field, this change called for a lengthening of the lead box surrounding the plate system, in order to retain field disturbance at the center of the chamber within the desired limits.

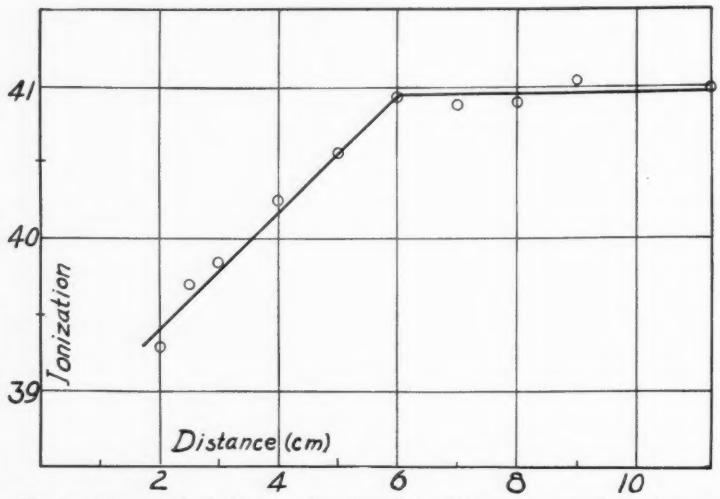

Fig. 1. Measured ionization as a function of the distance between the back guard wires and the grounded case.

Figure 1 shows a plot of the measured ionization current, using the 8-wire chamber, as a function of the spacing between the guard wires and end plates. It is evident that the field disturbance effectively disappears with the spacing greater than 5

[1] Lauriston S. Taylor and George Singer, Bureau of Stan. Jour. Research, 1930, **5**, 507 (RP 211).

[2] C. Snow, Bureau of Stan. Jour. Research, 1928, **1**, 513 (RP 17).

[3] Lauriston S. Taylor, Bureau of Stan. Jour. Research, 1932, **8** (RP 397). This particular 8-wire chamber has been preserved intact for a reference standard.

centimeters. As a safety margin, there is always employed a 7 cm. spacing on the 8-wire chambers, whereas a 4-cm. spacing had been found sufficient on the 12-wire chambers.

Similar studies were made with a guarded field chamber designed for low voltage radiations (4–90 kv.)[4] having four guard wires 1 cm. apart. In that case, a separation of 3 cm. between guard wires and end plates was found sufficient.

II. DISTRIBUTION OF POTENTIAL BETWEEN GUARD WIRES

It has been found by trial that exactly equal potential differences from one guard wire to the next is not strictly necessary. Figure 2 shows a plot of the measured ionization current as the potential difference between the central pair of guard wires is changed from zero to two times its normal value in the 8-wire chamber. In this, it is seen that a difference of ± 3 per cent from the normal potential difference causes a change of 0.1 per cent in the measured ionization current. It is, of course, a very simple matter to maintain the potential distribution between guard wires to within 0.5 per cent of the normal value. When using graphite or similar resistors in the potential divider, it is necessary only that their resistance remain very constant during a single determination.

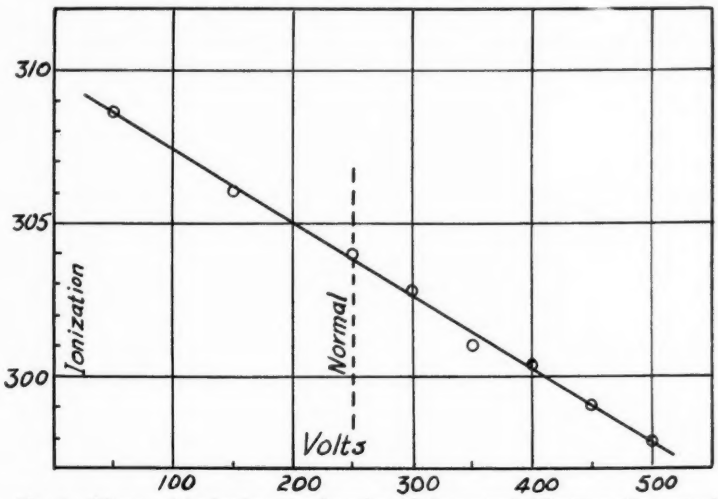

Fig. 2. Measured ionization as a function of the potential between the central pair of guard wires.

III. IONIZATION BETWEEN GUARD WIRES

It has been suggested[5] that the relatively intense ionization between the central pair of guard wires might be a possible source of difficulty in a guarded field ionization chamber. Such localized ionization can have two effects; one, to introduce a slight further transverse inhomogeneity in the ion density about the defined x-ray beam, and the other to cause an effective change of resistance between the central guard wires, thus disturbing the field within the chamber. The matter of uneven ion density is of no importance, for ordinary radiation intensities and provided that air absorption is negligible, since the measured ionization current is solely a function of the radiation flux density at the limiting diaphragm.[6] Since the resistance between successive guard wires is conven-

[4] L. S. Taylor and C. F. Stoneburner, Bureau of Stan. Jour. Research, 1932, **9**, 769 (RP 505).

[5] W. V. Mayneord, British Jour. Radiol., 1933, **6**, 205.

[6] L. S. Taylor, Bureau of Stan. Jour. Research, 1929, **3**, 857.

iently chosen at from 0.2 to 0.5 megohms, the change in effective resistance due to the air conductivity is less than 0.001 per cent. However, as noted above, the field at the center of the chamber is very insensitive to changes up to 5 per cent in the guard wire potentials and hence field disturbance caused by ionization between wires is negligible.

IV. DIAPHRAGMS

Following the international comparison, our chambers have been fitted with coin gold (90 Au, 10 Cu) limiting diaphragms. This was decided upon when it was found that lead or lead alloy diaphragms could neither be made nor measured with sufficient accuracy. The gold diaphragms,[7] which are 4 mm. thick, have been found to transmit through their boundary walls, less than $^1/_{10}$ per cent of a heavily filtered 195 kv. beam of radiation passing normally through the 8 mm. aperture. In making the international comparisons, a slightly tapered lead-cadmium alloy diaphragm was used. As compared with the effective cross-section of the aperture at low voltage, the tapered wall of this diaphragm was found to transmit effectively 1.2 per cent too much heavily filtered high voltage x-rays. This was due to transmission through the tapered part. Although this particular diaphragm is no longer used, it is being carefully preserved for comparison, because of its use in the international measurements. The gold diaphragms agree within experimental limits with this tapered wall diaphragm at the lower voltages, and transmit consistently the entire range of radiations.

In a more recently constructed chamber, the tube supporting the limiting diaphragm has been increased slightly in diameter, merely as a precaution to avoid scattering from the walls of the tube, although we have never been able to detect any such scattering. At the same time the diameter of the scattering diaphragm was increased from 12 to 14 millimeters. This facilitates alignment of the chamber in the beam, particularly at short distances (75 cm.) from the tube. The normal tube distance in routine calibration work is about 150 centimeters.

V. CREEPAGE OF CHARGE

In the chambers now used, the potential dividing resistances are mounted on a hard rubber panel just above the guard wires. When using a very sensitive detector system of low capacitance (FP-54, Electrometer tube, 15$\mu\mu$f), we have occasionally been troubled by charges induced on the collector electrode, apparently from creepage along the rubber surface. This arises usually in damp weather, and might be avoided by a different mounting of the resistors.

VI. COPLANARITY OF GUARDS AND COLLECTOR ELECTRODES

Another source of error has been found to lie in the failure to secure perfect alignment in the same plane, of the guard and collector electrodes. To avoid this, these three electrodes have been mounted in a separate rigid unit which can be readily detached from the rest of the system for inspection and adjustment. In this connection, the collector electrode is pulled tightly against the supporting yokes and ambers, after which the whole face of the assembly is first machined, then ground and polished as a single unit—thus assuring accurate coplanarity of the faces. This construction also facilitates the accurate measurement of the collector width and air gaps, since the unit can be easily placed upon the table of a micrometer microscope.

VII. TEMPERATURE OF CHAMBER

Temperature correction for a standard x-ray ionization chamber is roughly $^1/_3$ per cent per degree centigrade. Heat dissipation inside the guarded field chamber by the potential divider when operating at 1,500 volts is slightly less than one watt. To be certain that this did not influence the air temperature within a sealed chamber, simultaneous temperature measurements

[7] For description, see page 772 in Reference 4.

were made at the center and the outside of the chamber over a long period of time. A maximum difference of about 0.2° C. was noted.

VIII. CURRENT COMPENSATION

Attention should be called to another source of error which may be encountered in using any of the standard null methods of current measurements. It is of the "personal error" type and is caused by failing to maintain the collector system sufficiently near ground potential during the balancing process. We have found, depending upon the operator and the voltage sensitivity of the electrometer, that a given operator tends to over-balance or under-balance consistently during the exposure time. This can usually be avoided by increasing the voltage sensitivity to the point just below which operation becomes troublesome from electrical and mechanical instability. For example, in one standard tested, a consistent potential difference of 0.2 volt between guard and collector electrode was found to introduce an error of 2 per cent in the current measurement. This is, of course, an extreme effect, since, with experience, one tends to balance out the deviations.

DIVERTICULUM OF THE CARDIAC END OF THE STOMACH

WITH REPORT OF A CASE

By LOUIS NATHANSON, M.D., M.Sc., *and* MORRIS STEINER, M.D., *Brooklyn, N. Y.*

INTRODUCTION

GASTRIC diverticula are infrequent findings and relatively few cases are reported in the literature. Of the cases reported, the large majority occurred in females and were incidental findings having no characteristic symptoms. This report is of a diverticulum of the stomach occurring in a male and found together with a duodenal ulcer. Relatively few of the patient's symptoms were characteristic of duodenal ulcer, but could be attributed to the diverticulum.

INCIDENCE

The rarity of diverticula of the stomach when compared with similar lesions of the colon, duodenum, and esophagus is striking. Judd and Pollack (5) report that one-third of the colons showing pathology have diverticulosis or diverticulitis. The esophageal diverticula are somewhat more common than duodenal diverticula, both of which are relatively frequent findings. Diverticula of the stomach are found more frequently in lower animals, and Mellon (8) finds that the order of frequency is reversed in these instances with diverticula occurring more frequently in the stomach than in the remainder of the bowel. This is particularly true in the pig family. Gastric diverticula are much more prevalent in females than males; the first case recognized was in a woman with pernicious vomiting of pregnancy (Keith, 6). Hurst and Briggs (4) list five cases and Akerlund (1) four, all occurring in females. They explain this incidence as being due to increased intra-abdominal pressure occurring during pregnancy. On the other hand, Paul (9) reports six cases, four in males. Chronic constipation with straining at stool over a prolonged period of time may also be a contributing cause.

LOCATION

Diverticula may occur in any region of the stomach, but the most frequent site is at the cardiac end just below the entrance of the esophagus and somewhat posteriorly on the lesser curvature. Both from an anatomic and physiologic standpoint, this region of the stomach is a *locus minoris resistentiæ*, and the site most prone to the development of diverticula. Anatomically, the wall of the stomach is weak about the insertion of the esophagus, this region being deficient in all muscular coats. The longitudinal, circular, and oblique fibers are either thinned out or absent, and large blood vessels enter the stomach at this point, adding to the general weakness. Physiologically, this section of the stomach is under greater strain than other portions, with the exception of the pylorus. The cardia is fixed and the spasmodic entrance of food from the esophagus produces a variation in tension which weakens an already deficient wall.

Gastric diverticula are of the congenital or acquired type. As a rule, the congenital diverticula occur near the cardiac end of the stomach and the acquired near the pyloric canal. Of the cases reported near the pylorus, two showed evidence of carcinoma and a third showed precancerous changes (Charles Mayo, 7, Carman and Miller, 2, and Mellon, 8). The large majority of cases reported are of the congenital type and occur near the cardio-esophageal junction.

SYMPTOMS

As a rule, no characteristic symptoms are present, and the diagnosis is an incidental one in routine gastro-intestinal studies. Symptoms of indigestion, particularly in the morning, may be produced by stasis and food decompensation within the sac.

Fig. 1. Postero-anterior immediate study.

Fig. 2. Recumbent left oblique study during expiration.

Fullness and a dragging sensation in the epigastrium may be present after meals, depending upon the size of the pocket and the amount of food retained. Pressure over the epigastrium may elicit tenderness when the sac is distended and under tension. Diverticulitis is a rare complication and when present the symptoms are similar to those of diverticulitis elsewhere.

ROENTGEN APPEARANCE

The sac is visualized immediately after the opaque meal enters the stomach. It appears well circumscribed, rounded, and smoothly outlined, usually connected to the stomach by a narrow neck. No surrounding rigidity or infiltration is present and the sac is frequently movable. There is no evidence of spasm along the greater curvature. The size of the sac varies with the amount of contained food and may show a fluid level in the erect position. The pocket as a rule arises just below the entrance of the esophagus into the stomach on the lesser curvature and posterior wall. Retention in the sac may be present for a prolonged period of time, as shown in Gray's (3) case in which the retention was present for seven days. The roentgenographic examination should include studies in the erect, prone, oblique, and lateral positions in order to best visualize the origin and extent of the diverticulum. The pocket may be missed entirely if studies are made only in the postero-anterior position.

Pendergrass (10) finds that the sac is best visualized when studied during expiration, in the recumbent left oblique position. Roentgenoscopic examination should precede the roentgenographic studies, and the position that best demonstrates the sac determined before the films are made.

DIFFERENTIAL DIAGNOSIS

Roentgenologically, this lesion may simulate a penetrating gastric ulcer and must be differentiated from it. This possibility can usually be ruled out by the characteristic high location of the sac, the absence of surrounding and opposite spasm, and the absence of infiltration and rigidity. Pendergrass furthermore points out that diver-

ticula are larger during expiration than inspiration, whereas a diaphragmatic hernia appears larger during inspiration. He explains these findings as being due to the increase of intra-abdominal pressure and the encroachment of surrounding organs during inspiration.

Fig. 3. Serial study of deformed bulb.

CASE HISTORY

M. B., white male, a musician, aged 30 years, was first seen on April 9, 1935. He complained of heart burn, uncomfortable and distressed feeling after meals, and vomiting, particularly after breakfast. He was unable to state when symptoms first appeared except that he has had "stomach trouble" all his life. During the past two years the above symptoms have become exaggerated, which he attributed to his being under a constant mental strain, taking his meals at irregular intervals and to the excessive use of alcoholic beverages. He specifically stated that food and alkalies, such as bicarbonate of soda, exaggerated his symptoms. He has been markedly constipated all his life and has had to strain at stools to such an extent as to produce rectal bleeding on numerous occasions. His past history except for the "stomach trouble" and constipation has been essentially negative.

The general physical examination—except for the abdomen—was entirely negative. The abdominal examination showed

definite tenderness on palpation, two centimeters below the ensiform process and slightly to the left of the mid-line. He was present, and no appreciable tenderness was elicited at the time of examination although the patient stated that this was the

Fig. 4. Six-hour retention in the diverticulum.

stated that this was a persistent finding, particularly after a heavy meal. No other positive findings were demonstrable. Roentgen examination disclosed a definite pocket on the lesser curvature immediately below the cardio-esophageal junction (Fig. 1). This pocket was more prominent when studied in the oblique position (Fig. 2), showing its origin from the posterior surface of the lesser curvature. One could visualize a fluid level which was freely movable with change of posture. No surrounding infiltration, rigidity, or spasm usual site of tenderness. The first portion of the duodenum was constantly deformed and irregular, strongly suggestive of duodenal ulceration (Fig. 3). The six-hour study revealed evidence of retention within the diverticulum (Fig. 4). A diagnosis of gastric diverticulum and suggestive evidence of duodenal ulcer was made from the roentgen studies.

CONCLUSIONS

Diverticula of the stomach are rare occurrences and as a rule are incidental find-

ings, giving no characteristic symptoms. The large majority of cases occur in females, an incidence which is explained by the increased intra-abdominal pressure occurring during pregnancy. This case report is one of a diverticulum of the stomach occurring in a male patient in conjunction with a duodenal ulcer. The symptoms were not characteristic of ulcer but could be attributed to the diverticulum. Chronic constipation with severe straining at stools for many years undoubtedly produced increased intra-abdominal pressure and was probably a contributing cause.

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BIBLIOGRAPHY

(1) AKERLUND, A.: Diverticula of the Stomach from a Roentgenological Viewpoint. Acta Radiol., 1923, **2,** 476.

(2) CARMAN and MILLER: The Roentgen Diagnosis of Diseases of the Alimentary Canal, second ed. Saunders, Philadelphia, 1921.

(3) GRAY, I.: Diverticulum of Stomach. Am. Jour. Roentgenol. and Rad. Ther., 1925, **14,** 110–113.

(4) HURST, A. F., and BRIGGS, P. J.: Diverticula of the Stomach: A Possible Source of Error in the Radiological Diagnosis of Gastric Ulcer. British Jour. Radiol., 1925, **30,** 1–4.

(5) JUDD and POLLACK: Quoted by S. M. JORDAN and F. H. LAHEY, Diverticula of the Alimentary Tract. Surg. Clin. No. Am., 1926, **6,** 747–765.

(6) KEITH, ARTHUR: A Demonstration on Diverticula of the Alimentary Tract of Congenital or of Obscure Origin. British Med. Jour., 1910, **1,** 376–380.

(7) MAYO, CHARLES: Diverticula of the Gastro-intestinal Tract: Their Surgical Importance. Jour. Am. Med. Assn., 1912, **59,** 260–264.

(8) MELLON, R. R.: The Incidence of Carcinoma in Gastro-intestinal Diverticulosis. Surg., Gynec., and Obst., 1921, **33,** 177–182.

(9) PAUL, L. W.: Diverticula of the Fundus of the Stomach. RADIOLOGY, January, 1935, **24,** 47.

(10) PENDERGRASS, E. P.: Diverticulum of Upper End of Stomach. Surg. Clin. No. Am., 1931, **11,** 1493.

A PRELIMINARY REPORT ON THE EFFECT OF ULTRA-HIGH VOLTAGE IN GYNECOLOGIC CARCINOMAS[1]

By HENRY SCHMITZ, M.D., F.A.C.S., F.A.C.R., *Chicago*

From the Gynecological Department of Loyola University School of Medicine and the Mercy Hospital Institute of Radiation Therapy, Chicago, Illinois

A REPORT on early clinical results of ultra-high voltage roentgen therapy in cancers of the female pelvic organs may be of interest, though the scientific and clinical value may be questionable and only speculative. However, such reports may give one an idea on the justification of applying such short wave roentgens in the treatment of large and deep-seated cancers. From 400 to 1,000 kv. maximum roentgen therapy may be destined to solve the therapeutic problems twofold: (1) Replacing radium bombs, as there is not sufficient radium obtainable to meet our present needs; (2) solving the economic aspects of distant radiation therapy, as such roentgen rays would replace very expensive radium bombs. It should not be overlooked that the technic of the treatment is in an experimental stage. Future observations may compel one to modify the treatment either toward a decrease or an increase in the total radiation dose to assure the highest possible percentage of five-year cures.

The number of all cancers admitted from May 15, 1933, the day of dedication of the Institute, up to July 1, 1934, was 675. The number of cancers of the female pelvic organs was 97, that is, 14.87 per cent.

The voltages and total dose in r without back-scatter used in patients with an anteroposterior diameter of 21 cm. or less, measured just above the symphysis pubis, were as follows:

Date	Kilovolt max.	Dose in r without Back-scatter
to Sept. 1, 1933	500 to 600	5000
to Jan. 1, 1934	600	5000
to July 1, 1934	700	5000
since July 1, 1934	800	6000

The fields were 15 × 20 cm. and numbered two. In patients with an anteroposterior diameter greater than 21 cm., three or four fields were used, the size varying from 10 × 20 to 15 × 20 cm. The filter resembled an equivalent of 18 mm. of copper of the half value layer. For instance, the H.V.L. of 800 kv. max. is 8.2 mm. copper, hence the filter is an equivalent of 8.2 mm. copper. The F.S.D. has been from eight to ten times the depth of the tumor, to assure the most favorable conditions of absorption in the tumor. In selected cases from 1,200 to 2,400 mg.-el.-hr. of radium, applied intra-uterine, were added to stimulate epithelization to more rapid repair. Roentgen rays were considered of prime importance, and always given first, while radium rays were given

[1] The statements herein embodied were made in the course of discussion before the Radiological Society of North America, at the Twenty-first Annual Meeting, at Detroit, Dec. 2–6, 1935.

TABLE I

Clinical Group	Primary Carcinomas			Recurrent Carcinomas		
		Result of Treatment			Result of Treatment	
	No.	Arrested	Died or Unknown	No.	Arrested	Died or Unknown
I	1	1				
II	5	4	1			
III	14	9	5	8	3	5
IV	10	3	7	40	8	32
Total	30	17	13	48	11	37

a secondary value and used only to complete or accelerate surface healing.

The time elapsed since the treatment in the cases reported varied from 18 to 30 months. The result of the treatment is given as *arrested* if symptomatic or anatomic healing ensued, as determined by follow-up examinations and follow-up biopsies, if advisable; or as *died or unknown* if the patient succumbed, did not improve, or did not report for re-examinations. The cases were also divided into primary and recurrent. The latter followed either operations or radiation treatment given elsewhere. The cases also are divided into clinical groups according to the extent of the disease. The factors of clinical grouping according to our method are well known and, therefore, are not reiterated.

The total number of carcinomas of the female pelvic organs examined up to June 1, 1934, was 89; not treated were 11 cases, hence the report is based on 78 carcinomas. The results are contained in Table I.

There were three stump cancers among the primary and five stump cancers among the recurrent carcinomas, or 10 per cent.

The percentage of arrested primary cancers is 56.67 and of arrested recurrent cancers 22.92. These values are, as such, of course, of no import; however, they are of some value if compared with similar percentages obtained in the treatment of cancers with different technics of radiation treatment.

Table II gives the factors used in our clinic since 1914. The changes coincide with improvements in Coolidge tubes and transformers.

The cases of the first year of each period were taken and the results of treatment were recorded as done in Table I. Table III gives these results:

The percentage of survivals in the primary cases in each period were: 1914, 22.7; 1921, 37.8; 1926, 36.84; 1933, 56.67.

If these preliminary survival rates in primary carcinomas are compared with the absolute five-year curability rates of each period, then the ratio of difference of the preliminary and five-year survivals can be obtained. This is shown in Table IV.

Should these ratios be applied to the preliminary results with ultra-high voltage therapy then the 56.67 per cent would be reduced to about 35 per cent if the first period ratio prevailed, to about 40 per cent if the second period ratio prevailed, and to about 45 per cent if the third period ratio prevailed. I do not wish to make any predictions, but no matter how the results are evaluated they should become better as voltages are increased. This statement is corroborated by the five-year cures in the different periods. The radium dose remained the same while the roentgen quality

TABLE II

Periods	Radium Mg.-el.-hr.	Roentgen Kv. Max.	F.S.D. (Cm.)	Filter in Mm.			Fields Size and No.		H.V.L. in Mm. Cu	r in Air
				Al	Cu	Sn	Sq. Cm.			
1914 to 1920	3,600	90 to 140	30 to 65	10.0 or 1.0	0.5		25 or 225	9 to 14 or 2 to 4	0.5	675
1921 to 1925	3,600	200	65	1.0	1.0		300	2 to 4	1.58	900
1926 to 1932	3,600 to 4,800***	200	65	1.0 1.0	1.0 2.0		300	2 to 4	 1.94	1,375* 1,800**
1933	1,200	800	70	3.0	4.5		300	2 to 3	8.80	3,000**

* Five fractional doses each of 275 r every other day to each field.
** Ten fractional doses one every other day to each field.
*** Three fractional doses each 1,500 to 1,600 mg.-el.-hr. in 8-day intervals.

was changed to shorter wave length as tubes and transformers were improved and an increase in the total dose and total time by fractionation was made. With each change the percentage of five-year good end-results increased.

The results in the recurrent carcinomas are negligible. This is due to the large predominance of Clinical Group IV cases. Results can be improved in only two ways: (1) The surgeon could refuse to operate without a pre-operative adequate radiation treatment; (2) the surgeon could refer the patient for adequate radiation treatment immediately after operation.

COMMENT

The percentage of early results of the radiation treatment of cancer improved in the voltage and hence increase in the depth doses due to the increased intensities. This contention may be proven for 800 kv. roentgen rays by clinical observations and physical calculations.

TABLE IV

Year	Preliminary Results after from 18 to 30 Months	Absolute Curability	Ratio
1914	22.7	14.70	About 3:2
1921	37.8	26.77	" 4:3
1925	36.84	30.92	" 6:5
1933	56.67	?	?

A patient had two metastatic growths, one on each temporal bone area, from a primary arrested carcinoma of the left breast. Treatment with 800 kv. was advised. A dose of 250 r was applied over the left temple and the next day a dose of 250 r over the right temple. The distance between the two fields was 14 cm.; hence each area received from the opposite field an additional 125 r, or a total to each field of 375 r. No further treatments were given due to the severe subjective reaction, mainly vomiting and extreme prostration.

TABLE III.—RESULTS AT EIGHTEENTH MONTH

			Primary			Recurrent	
	Cl. Gr.	No.	Arrested	Died or Unknown	No.	Arrested	Died or Unknown
1914	I	2	2		1		1
	II	1	1				
	III	10	1	9	1		1
	IV	9	1	8	8		8
	Total	22	5	17	10	0	10
1921	I	2	2				
	II	8	4	4			
	III	12	5	7	4	2	2
	IV	15		15	5		5
	Total	37	11	26	9	2	7
1926	I						
	II	7	3	4			
	III	5	3	2			
	IV	7	1	6	2	1	1
	Total	19	7	12	2	1	1
1933	I	1	1				
	II	5	4	1			
	III	14	9	5	8	3	5
	IV	10	3	7	40	8	32
	Total	30	17	13	48	11	37

Within four weeks an epilation occurred, which was complete within another two weeks. The areas were completely bald for two months, when the hair regrew.

A complete but reversible epilation may be induced with a 70 per cent erythema skin dose or 630 r applied with 200 kv. roentgen rays. This means that for this type of tissue, namely, the hair follicles, the effect of 375 r with 800 kv. equals the effect of 630 r with 200 kv. Hence, the biologic effect of 800 kv. roentgens is 60 per cent more intense than that delivered with 200 kv. for the same type of tissue at a dose ratio of 1 r to 1.4 r. Lauritsen came to a similar conclusion by calculation. With 200 kv. max. (100 kv. equivalent), one r represents a total energy absorption of 3,500 ergs per square centimeter, and with 800 kv. max. (400 kv. equivalent), one r represents 2,800 ergs per square centimeter. If 500 r at 200 kv. max. produce skin erythema, then 1,000 r will be required to produce a similar reaction with 800 kv. The total energy delivered into the body in the two instances may be compared. At 200 kv. max., 500 r represents 500 × 3,500 or 1,750,000 ergs per square centimeter; at 800 kv. max., 1,000 r represents 1,000 × 2,800 or 2,800,000 ergs per square centimeter. This means that the higher voltage delivers 60 per cent more energy into the body as a whole when the same skin reaction has been produced.

CONCLUSION

The interpretation of the preliminary results of treatment with ultra-high voltage roentgen therapy presented can only be suggestive or speculative. They show a higher percentage of survivals after from 18 to 30 months than were obtained with 140 and 200 kv. max. roentgens, either with single massive applications or broken treatments. The final acid test will be the percentage of five-year cures. The higher percentage in early arrests of cancers of the cervix is due to the absorption of greater intensities (60 per cent) in the depth with 800 kv. roentgen rays than that produced by 140 or 200 kv. roentgen rays. However, one should remember that 200 kv. roentgen rays and gamma rays have proven of definite and positive value, and hence will continue to be used as in the past. It is in the large, deep-seated, and massive cancers as those of the pelvic organs, the chest, the brain cavity, the oral cavity, and the large breasts, that 800 kv. roentgen rays are indicated.

DISPLACEMENTS OF THE LEFT KIDNEY IN THE DIAGNOSIS OF TUMORS OF THE LEFT FLANK AND ABDOMEN

By PHILIP SHAMBAUGH, M.D., *Boston*

From the Urological Clinic of the Peter Bent Brigham Hospital, Boston

THE urologist and roentgenologist are frequently called upon to assist in the differential diagnosis of tumors in the left side of the abdomen. Enlargement of the spleen is not uncommonly indistinguishable from a tumor of the left kidney by physical examination alone, and either of these conditions may be simulated by retroperitoneal tumors. The importance of accurately distinguishing renal and retroperitoneal tumors from the splenomegalies is obvious, for the treatment of the latter is frequently a medical problem whereas the former conditions usually demand surgical intervention. Moreover, in splenomegalies which require surgery the operative approach is as a rule quite different from that for the removal of tumors of the kidney or retroperitoneum.

The roentgen-ray provides the most important means of assisting in this differential diagnosis. Displacements and gross deformities of the kidney are frequently shown in a roentgen-ray film of the abdomen, and these abnormalities can be demonstrated with further accuracy by the visualization of the upper urinary passages after the injection of contrast media. Tumors of the kidney can be usually identified by the more or less characteristic deformity of the renal pelvis. However, the differentiation between retroperitoneal and intraperitoneal tumors depends largely upon their effect on the position of the kidney. A number of writers have made the observation that tumors within the peritoneal cavity fail to dislocate the kidney, whereas retroperitoneal tumors in this region almost invariably do so. This finding has been particularly noted in the case of enlargements of the spleen, since these constitute practically all of the intraperitoneal tumors in the left side of the abdomen. Interest in this subject was aroused by the apparently unique observation of dislocation of the left kidney in a patient with an enlarged spleen. This study, therefore, was undertaken to determine the accuracy of a differential diagnosis made on the basis of the position of the left kidney, and more particularly to inquire whether other similar instances could be found among the hospital records. Tumors of the kidney itself have not been considered in this study.

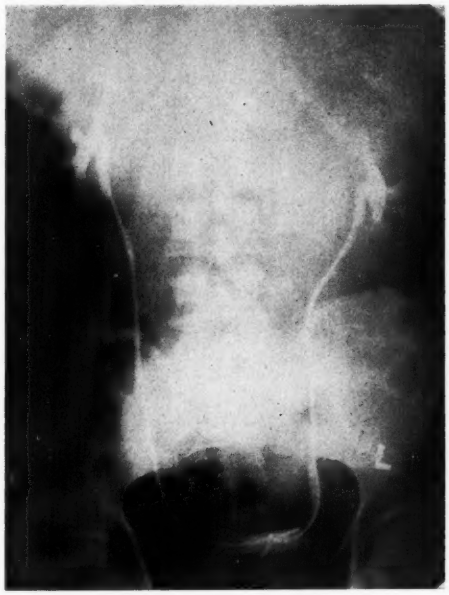

Fig. 1. Case 2. Retrograde pyelogram, showing lateral displacement of the left kidney by a retroperitoneal lymphoma.

A review of the records of the Peter Bent Brigham Hospital for the last 22 years disclosed 24 cases in which the urologist was called upon to determine the nature of a puzzling mass in the left flank or abdomen. (This number does not include the numerous instances in which the mass proved to be the kidney itself.) In seven of

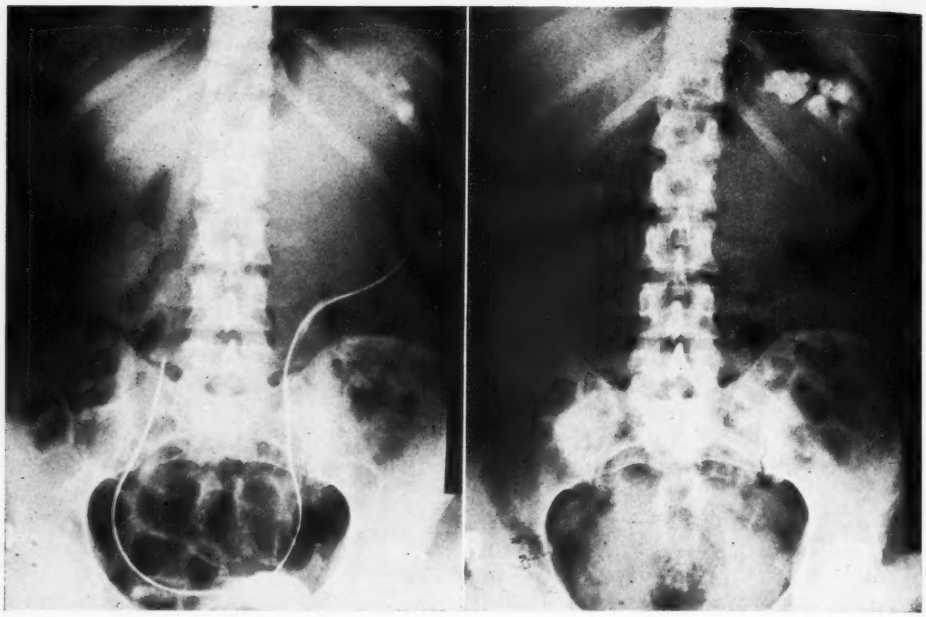

Fig. 2-*A*. Fig. 2-*B*.

Fig. 2-*A*. Case 5. Retrograde pyelogram, showing lateral displacement of the left ureter and rotation of the kidney by a retroperitoneal fibroma.

Fig. 2-*B*. Case 5. Intravenous urogram, showing more clearly the upward dislocation and rotation of the left kidney.

Fig. 3. Case 5. Photograph of the fibroma after surgical removal.

these cases the kidney was visualized merely by a plain film of the abdomen; in 16 retrograde pyelograms were made, and in one, intravenous pyelograms.

Left Kidney Displaced.—In eight cases, the left kidney was definitely dislocated out of its normal position. Surgical intervention in six of these disclosed an extrarenal retroperitoneal tumor (Table I). Three of these were found to be malignant lymphomas (Fig. 1), one a neurofibrosarcoma, one a benign fibroma (Figs. 2 and 3), and one a pancreatic cystadenoma.

In two cases, the mass proved to be an enlarged spleen. In the first of these, roentgen-ray studies had shown the left kidney a full six or eight inches below its normal position. At operation, however, the spleen, which filled the whole left side of the abdomen, was found not to be in immediate relationship to the kidney. Since the ureter was short and the kidney was fixed at the brim of the pelvis, it was felt that the kidney was congenitally low and not displaced by the spleen. In the second

TABLE I.—LEFT KIDNEY DISPLACED FROM NORMAL POSITION

Case No.	Findings on Physical Examination	Method of X-ray Examination	X-ray Findings	Pathologic Findings
1	Mass in left flank, kidney or spleen (?)	Retrograde pyelography	Kidney prolapsed, lying between twelfth rib and iliac crest	Retroperitoneal lymphosarcoma, lying between spleen and kidney and displacing the latter downward
2	Mass in left upper abdomen, 24 cm. by 12 cm.	Retrograde pyelography (Fig 1)	Kidney displaced laterally	Retroperitoneal lymphoma
3	Mass "size of football" filling left abdomen	Retrograde pyelography	Kidney displaced upward and rotated on longitudinal axis	Retroperitoneal lymphosarcoma
4	Mass in left upper abdomen, 15 cm. in diam.	Retrograde pyelography	Kidney displaced upward and outward	Retroperitoneal neurofibrosarcoma
5	Hard tender mass in left upper abdomen, the size of a grape-fruit	Retrograde pyelography (Fig. 2)	Kidney displaced upward and rotated on longitudinal axis	Retroperitoneal fibroma (Fig. 3)
6	Tender mass in region of spleen extending 10 cm. below costal margin	Retrograde pyelography	Kidney rotated on longitudinal axis	Cystadenoma of the pancreas
7	Mass in left flank extending from costal margin to iliac crest	Retrograde pyelography	Kidney displaced downward 15 or 20 cm.	Splenomegaly (however, not associated with kidney, which was fixed at the pelvic brim)
8	Mass filling left flank, 15 cm. in diam.	Retrograde pyelography (Fig. 4)	Kidney displaced medially	Splenomegaly

TABLE II.—LEFT KIDNEY NOT DISPLACED

Case No.	Findings on Physical Examination	Method of X-ray Examination	X-ray Findings	Final Diagnosis
9	Mass filling whole left abdomen	Intravenous pyelography	Kidney normal	Peritoneal fibrosarcoma
10	No palpable mass (marked obesity)	Intravenous pyelography	Spleen moderately enlarged, kidney normal	Splenomegaly, cause undetermined
11	Mass descending 4 cm. below left costal margin	Retrograde pyelography	Spleen enlarged, kidney normal	Splenomegaly, cause undetermined
12	Mass extending 8 cm. below left costal margin	Plain film of abdomen	Spleen enlarged, kidney normal	Splenomegaly, cause undetermined
13	Mass extending 8 cm. below left costal margin	Plain film of abdomen	Spleen enlarged, kidney normal	Splenomegaly, cause undetermined
14	Mass from left costal margin down to level of umbilicus	Plain film of abdomen	Kidney slightly enlarged, but not displaced	Splenomegaly, cause undetermined
15	Mass in left upper abdomen measuring 12 by 7 cm.	Retrograde pyelography	Spleen enlarged, kidney normal	Splenomegaly, lymphoblastoma
16	Mass extending 18 cm. below left costal margin	Plain film of abdomen	Kidney normal	Splenomegaly (?)
17	Mass extending 15 cm. below left costal margin	Retrograde pyelography (Fig. 5)	Spleen enlarged, kidney normal	Splenomegaly, cause undetermined
18	Mass from left costal margin to 5 cm. below level of umbilicus	Retrograde pyelography	Kidney unusually high, otherwise normal	Splenomegaly, probably malarial
19	Freely movable mass in left upper abdomen, size of an orange	Retrograde pyelography	Kidney normal	Splenomegaly, cause undetermined (wandering spleen)
20	Mass filling whole left abdomen up to 4 cm. below costal margin	Retrograde pyelography	Kidney normal	Splenomegaly, cause undetermined (wandering spleen)
21	Mass filling whole left abdomen to 2 cm. below iliac crest	Retrograde pyelography	Kidney normal	Hemangioma of spleen
22	Mass filling whole left abdomen	Plain film of abdomen	Kidney normal	Splenomegaly, cause undetermined
23	Mass filling whole left abdomen	Plain film of abdomen	Kidney normal	Splenomegaly, probably malarial
24	Mass filling whole left abdomen	Retrograde pyelography	Kidney normal	Splenomegaly, cause undetermined

Fig. 4.

Fig. 5.

Fig. 4. Case 8. Retrograde pyelogram, showing medial displacement without rotation of the left kidney by an enlarged spleen.

Fig. 5. Case 16. Retrograde pyelogram, showing the left kidney in normal position in spite of a marked enlargement of the spleen.

case, there was a medial displacement which was shown to be caused by the splenomegaly. Inasmuch as a review of the literature has revealed no similar instance of displacement of the kidney by a large spleen, we are reporting this case in detail.

The patient, a 65-year-old Russian Jew, was admitted for repair of an indirect inguinal hernia. In addition to the large hernia, examination disclosed an elevated blood pressure, an enlarged heart with early congestive failure, and a large abdominal mass, filling the left flank from the costal margin to the anterior superior iliac spine. This was somewhat flattened in its anteroposterior diameter, the estimated measurements being 15 by 15 by 6 centimeter. A retrograde pyelogram showed a medial displacement of the left kidney (Fig. 4).

In spite of the patient's age and poor general condition, repair of the hernia was considered advisable because he was completely incapacitated by it, the least exertion causing painful strangulation which was reduced with difficulty. He stood the operation well and was apparently making a good recovery when, ten days postoperatively, uremia supervened and he died of a terminal bronchopneumonia.

Postmortem examination revealed a large spleen, weighing 935 grams, which had insinuated itself behind the descending mesocolon in such a way as to displace medially the descending colon and the left kidney. There were no adhesions between the spleen and the kidney. The nature of the splenomegaly remained obscure.

Left Kidney Not Displaced.—In 16 cases, roentgen-ray studies showed the left kidney to be in its normal position, and in all of these the mass was found to be intraperitoneal (Table II). In one instance the mass proved to be a peritoneal fibrosarcoma, the other 15 cases being diagnosed as splenomegaly. In this group, the size of the spleen varied from a moderate enlargement with the lower pole just palpable below the costal margin, to a massive

splenomegaly filling the whole left abdomen. In two instances the spleen was freely movable on an elongated pedicle, the so-called "wandering spleen." Regardless of the size of the spleen, roentgen-ray studies in all showed no displacement of the left kidney (Fig. 5).

SUMMARY

When the left kindey is found displaced by a mass in the left flank or abdomen, the mass will usually prove to be extraperitoneal. Congenital malposition of the kidney may be confused with a true displacement.

Enlargement of the spleen, even when massive, almost never disturbs the position of the left kidney. An exceptional instance is reported in which such a dislocation did occur.

THE VALUE OF THE LEFT ANTERIOR OBLIQUE POSITION IN CHOLECYSTOGRAPHY

By SAMUEL ZALDIN, M.D., *Brooklyn, N. Y.*

THE recent literature concerning cholecystography has stressed the causes of error in roentgen diagnosis of diseases of the gall bladder, and has laid particular emphasis on uniformity of technic, dosage of dye, preparation of the patient, etc., in order to diminish the percentage of diagnostic error. It is my purpose to call attention to those cases in which, though the accepted technic has been followed and lack of absorption of the dye has been ruled out, failure of visualization has, nevertheless, resulted. In many such cases this failure may be overcome by studies in the so-called left anterior oblique position, first described by Chiray, Lomon, and Albot.

Many gall bladders are situated mesially, rather than in their usual location, and some may even overlie the vertebral column. This is especially true in thin individuals of the ptotic type. By tilting such patients in the left anterior oblique position at an angle of 45 degrees, the spine is projected toward the left and the sac becomes readily visible. This position has been adopted as a routine by Held and Goldbloom, who have well illustrated its advantages over the usual position in cases in which adhesions are suspected, or in which the usual clarity of outline of the gall bladder is lost in overlying gas or other extraneous shadows.

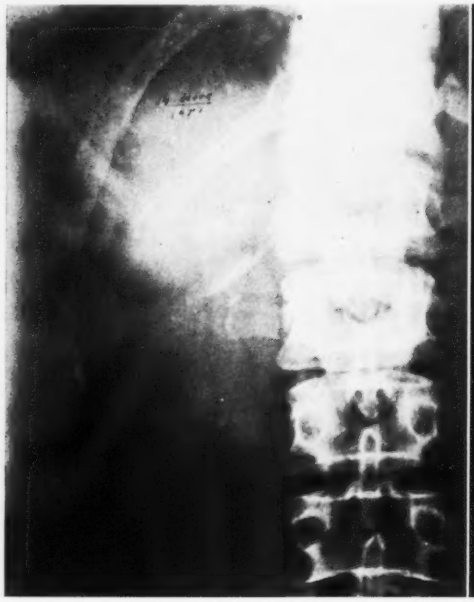

Fig. 1

Fig. 2

Fig. 1. Case 1. Usual anteroposterior position; 14-hour film. Gall-bladder shadow is not visible. Calcific deposits are in costal cartilages.

Fig. 2. Case 1. Left anterior oblique position; 14-hour film. The gall bladder, containing two calculi, is definitely outlined.

The following two cases represent instances of non-visualization of the gall bladder in the usual anteroposterior position. In the left oblique position, however, not only was the bladder visualized but pathology definitely ruled out in one of them.

Case 1. R. G., female, 52 years of age, weight, 123 pounds, complained that for five years she had suffered with recurrent

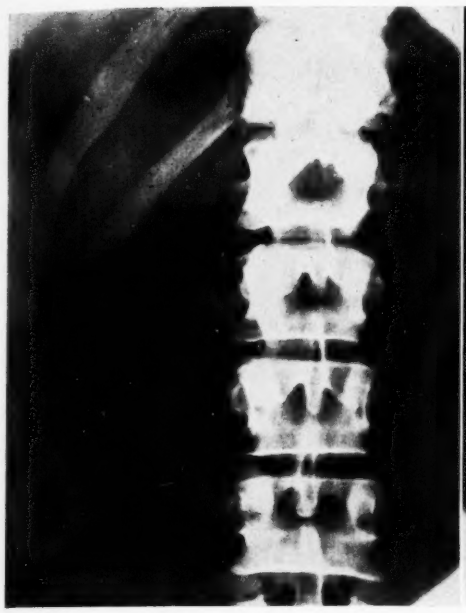

Fig. 3.

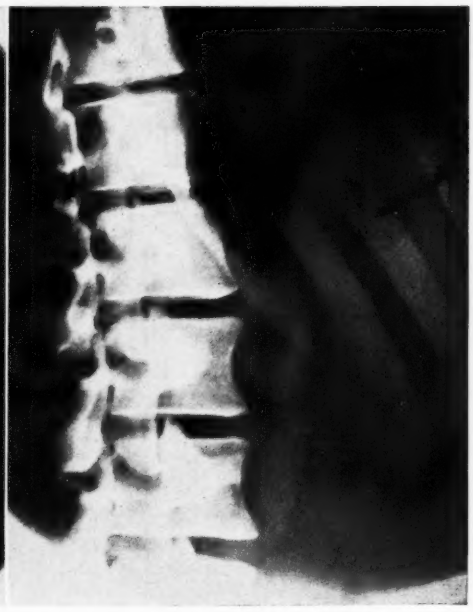

Fig. 4.

Fig. 3. Case 2. Usual anteroposterior position; 14-hour film. The gall bladder is not visualized.
Fig. 4. Case 2. Left anterior oblique position; 14-hour film. An elongated gall bladder, not pathologic, is visualized.

attacks of colicky pain in the epigastrium, radiating to the back and right shoulder. The physical examination revealed a marked tenderness in the mid-epigastric region and practically none in the right upper quadrant. The 14-hour film in the anteroposterior position failed to visualize the gall bladder. Bearing in mind the possible loss of the gall bladder in the spinal shadow, films were taken in the left anterior oblique position. These definitely visualized a faintly filling gall bladder containing two calculi (Figs. 1 and 2).

Case 2. A. G., female, 24 years of age, weight, 102 pounds, complained that for two years she had suffered with indefinite gastric symptoms, having some pain in the epigastrium. The stomach and duodenum were negative. An x-ray examination of the gall bladder revealed no definite shadow in the anteroposterior position. In the left anterior oblique position, the gall bladder was readily portrayed and no pathology was demonstrated. Had the latter position not been employed, non-visualization might readily have been interpreted as due to a pathologic gall bladder (Figs. 3 and 4).

CONCLUSION

The left anterior oblique position is important in cholecystography, and is especially indicated in those cases of non-visualization in which a mesial location of the gall bladder is suspected. It is probable that a number of normal gall bladders, being completely hidden by the spine, have been diagnosed as pathologic, simply because they have not been visualized by the technic commonly in vogue.

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BIBLIOGRAPHY

(1) KIRKLIN, B. R.: Jour. Am. Med. Assn., Dec. 30, 1933, **101,** 2103–2105.
(2) CHIRAY, M., LOMON, A., and ALBOT, G.: La vesicula biliaire, sa topographie radiologique et clinique, son exploration par le palper abdominal. Presse méd., Nov. 6, 1929, **37,** 1437–1440.
(3) HELD, I. W., and GOLDBLOOM, A. A.: Am. Jour. Roentgenol. and Rad. Ther., April, 1930, **24,** 313–316.

DIAGNOSTIC FEATURES OF ILEUS

By ELDRIDGE L. ELIASON, M.D., *and* JULIAN JOHNSON, M.D., *Philadelphia*

THE term "ileus" is derived from the Greek, meaning *to twist.* Dorland's dictionary defines it as "severe colic, due to intestinal obstruction." Bottomley states that "ileus is a term used to designate as a whole that group of symptoms (colicky pain, constipation or obstipation, distention of the intestine, and nausea and vomiting) which indicate the existence of an intestinal obstruction. Most writers, however, use the term "ileus" as synonymous with "intestinal obstruction," and such is our interpretation.

It will be noted that no mention is made of peristaltic action in the above descriptions, and the reason is that its absence or presence depends upon the type of ileus, namely, whether it is paralytic or mechanical. In paralytic, reflex or adynamic ileus, the peristalsis is absent in the affected gut, although it is possible that active peristalsis may exist in the unaffected gut proximal to the obstructed segment. In the mechanical and dynamic types, peristalsis is hyperactive, until late in the course of the disease when, due to overdistention, the gut becomes paralyzed and peristalsis ceases.

As far back as records exist intestinal obstruction has been attended by a high mortality. Even to-day records show a disgraceful and appalling death rate, namely, 50 per cent. Strangulation types head the list. Many careful analyses have shown conclusively that as the duration of the obstruction increases the mortality increases. Richardson has stated that the longer a patient with intestinal obstruction lives before operation, the shorter his life after operation. Another axiom is, Never let the sun set upon intestinal obstruction without relief.

It is true that Wangensteen suction has done much to relieve symptoms, and blood chemistry findings have done much to combat lethal chemical changes, with some slight resultant lowering of mortality, yet the chief factor in reducing mortality has clearly and repeatedly been shown to

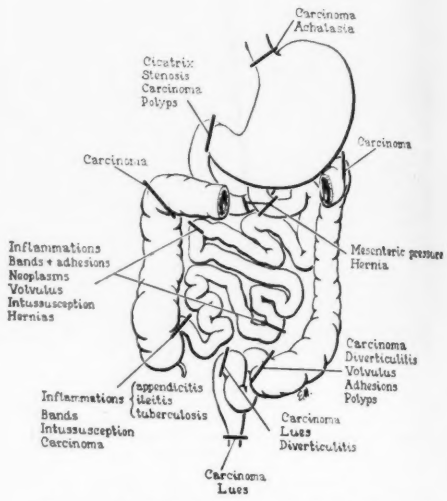

Fig. 1. Modification of chart from Babcock's Surgery.

be early diagnosis. Our knowledge of the physiology of the disease and the cause of death is still woefully scant. It has, therefore, become apparent that if the mortality is to be reduced, in the light of our present knowledge, the diagnosis must be made earlier, that is, in hours rather than in days. Thus it is not without reason that the surgeon has turned for aid to that most renowned diagnostician, the roentgenologist.

Schwarz, in 1911, was probably the first one to demonstrate intestinal obstruction with the x-ray. Although he used barium by mouth, he saw multiple fluid levels even before giving barium. In 1913, Assmann called attention to the distended loops of the small intestine on the roentgenograms in five cases shown at autopsy to have intestinal obstruction. Case, writing in 1915, is accredited with being the

Fig. 2.

Fig. 3.

Fig. 2. Case 1. H. P., aged 59 years, who suffered attacks of distention and colicky pains for several years which became worse in the last three months. The condition became extreme upon the day of admission. Visible peristalsis. Blood calcium normal. Cecostomy done. Recovery. Symptoms relieved by calcium and parathormone therapy. X-ray diagnosis was megacolon, with marked distention of large intestine, and some of the small intestine.

Fig. 3. Case 2. J. E., aged 37 years, who had a cholecystectomy done for subacute calculous cholecystitis. The patient became distended and vomited on the third day. Peristalsis was absent. Cecostomy was done on the seventh post-operative day. Recovery. Clinical diagnosis was paralytic ileus. X-ray diagnosis was marked distention of the large and small intestines.

first in this country to demonstrate the value of x-ray in the diagnosis of acute intestinal obstruction. In recent years there have been many contributions of both experimental and clinical nature.

The experimental work has come chiefly from the laboratories of surgical investigators. Ochsner found that after experimental strangulation or simple obstruction, the diagnosis could be made in from one to three hours by x-ray examination which demonstrates gas in the small intestine. Similar findings have been reported by other workers, the time interval varying up to six hours. Wangensteen and his co-workers are certain that accumulations of gas in the small gut indicate a pathologic condition; yet, they point out that by means of the x-ray one cannot differentiate between simple obstruction and that more serious condition, strangulation. Hibbard, Swenson, and Lewis occluded the mesenteric artery or vein and found gas in the small intestine in from two to six hours, but by x-ray it was indistinguishable from a mechanical obstruction.

Zuntz and Tache have shown that normally the gas in the intestine is absorbed by the blood stream and eliminated by the lungs; only about one-tenth is expelled by rectum. Thus it might be expected, as shown by Ochsner, that gas appears earlier in strangulation than in simple obstruction. Yet as has been pointed out, the two conditions are indistinguishable by x-ray. This is probably due to the fact that as the gut becomes distended due to simple obstruction, the pressure on the intramural vessels cuts

Fig. 4.

Fig. 5.

Fig. 4. Case 3. C. B., aged 36 years, who suffered a cramp-like pain in the abdomen of three days' duration. There was abdominal tenderness and rigidity, constipation and persistent vomiting. Peristalsis had decreased. X-ray diagnosis was moderate distention of the small intestine. Operative diagnosis was three feet of gangrenous small intestine due to mesenteric thrombosis.

Fig. 5. Case 4. H., an adult who had multiple fractures of the pelvis. There was distention. Peristalsis had decreased. Clinical diagnosis was reflex ileus due to multiple fractures of the pelvis. X-ray diagnosis was multiple fractures of the pelvis. There was distention of the large and small intestines.

down the blood supply, reducing absorption of gas. Thus a vicious circle is established. When the gas pressure in the intestine equals the diastolic blood pressure, absorption of gas stops, as recently shown by Gatch and Culbertson.

The presence of abnormal amounts of gas in abnormal locations is taken as x-ray evidence of ileus. The presence of multiple fluid levels is even more conclusive. When the condition is advanced the diagnosis may be evident to the roentgenologist. However, at that point the diagnosis is also evident to the surgeon. The question then resolves itself around those patients who present suggestive but not conclusive signs of ileus. Can the roentgenologist present additional evidence that will turn a doubtful diagnosis into a positive one? There are many types of ileus which the surgeon has had to identify. Can the roentgenologist come to the aid of the surgeon in this differential diagnosis? The treatment differs frequently and the best results are to be obtained by an early diagnosis. Can pocketed gas in small amounts remaining stationary be considered as this early sign?

Fig. 6. Case 5. C., adult. Diagnosis of acute disseminate encephalo myelitis of some duration. While in the neurologic ward the patient developed distention with tinkling peristalsis. X-ray diagnosis was distention of both the large and small intestines. Clinical diagnosis was ileus of neurogenic origin. The patient was relieved by enemas.

The accompanying table shows some of the causes of ileus, using that term in its

broader sense of bowel obstruction. If mechanical, there exists in the early hours, obstipation, colicky pains, increased peristalsis, projectile vomiting, distention; if paralytic, adynamic, or reflex, there exists obstipation, constant pain, absent peristalsis, regurgitant vomiting, and distention. Thus as seen there exists a marked clinical difference in the early, but a great similarity of findings in cases of late diagnosis. These conditions so nearly simulate each other from the x-ray standpoint that at present it is difficult or even impossible to differentiate between them. The result has been that in ordinary usage ileus means gas in abnormal amounts or positions in the intestinal tract rather than colicky pains in the abdomen. This must be borne in mind in considering the above classification of ileus.

In the usual case a careful consideration of this clinical picture will denote the type of ileus. The differentiation, however, may be surprisingly difficult or impossible at times. If the history and surrounding circumstances of the case do not answer the question of mechanical or paralytic ileus, the decision must be made on the presence or absence of colicky pains and fighting peristalsis. The picture is frequently complicated also by a localized area of "paralytic ileus" which allows gas and liquid to go through but not at its normal rate. As a result, mechanical ileus with fighting peristalsis develops in the proximal intestine.

I think all agree that an ileus of the small gut will result in gas accumulation above the obstruction, and that an ileus in the large gut results in gas collection in the colon above the obstruction. In the earlier cases of the latter, the gas is limited to the large gut but in later cases gas appears in the small gut as well. Is this not true?

It is said that 90 per cent of acute obstructions occur in the small gut. It is further well known that small gut obstructions are accompanied by more sudden and severe pain and vomiting and exaggerated peristalsis, whereas colonic obstruction advances more slowly and the symptoms are less severe.

Fig. 7. Case 6. C. K., aged 27 years, who was rolled upon by her horse during a fall. There developed immediate paralysis of the lower extremities. X-ray film taken one and one-half hours after fall. Peristalsis was absent. Clinical diagnosis was paralytic ileus. X-ray diagnosis was distention of the loops of the small intestine. (Fracture dislocation of spine.)

The post-operative case with ileus undoubtedly presents the greatest problem to the surgeon. When the ileus develops in the first two or three post-operative days and the abdomen is silent it is almost certain to be adynamic or paralytic ileus. If it develops after the fifth day, it is more apt to be mechanical. But as yet we have found no satisfactory way of determining with certainty whether there is an actual mechanical obstruction or whether there is a local paralysis which has produced a mechanical type of ileus in the proximal intestine. Nevertheless, the surgeon is in a better position than the roentgenologist to make the differential diagnosis.

Fig. 8.

Fig. 9.

Fig. 8. Case 7. S. M., aged 42 years. The patient had had an appendectomy and a cholecystectomy two years previously, and vague abdominal complaints since then. Colicky abdominal pain and intermittent vomiting for 48 hours. Abdomen soft and not distended. Peristalsis decreased. One "peristaltic rush" was heard. The patient had had some sedative. Clinical diagnosis was intestinal obstruction. X-ray diagnosis was a distended loop of the small intestine which stayed in the same position for 12 hours. Operative diagnosis was partial intestinal obstruction due to a band constricting the ileum.

Fig. 9. Case 8. R. W., aged 35 years, who had a right inguinal hernia irreducible for one week. The patient had vomited but was not greatly distended. At operation four necrotic rings on the small intestine were oversewed. Marked distention with "fighting peristalsis" developed. Fecal-colored material by Wangensteen. Bowel movements began on the third post-operative day. The distention disappeared on the tenth post-operative day. Recovery. Clinical diagnosis—The swelling around the oversewed intestine caused temporary obstruction. X-ray diagnosis—Marked distention of small intestine.

It is our belief that too much has been asked of the roentgenologist when he has been requested to differentiate between the types of ileus. How can he do more than point out where there are abnormal accumulations of gas? It is true that the roentgenologist has certain sign posts which may lead one way or the other, but can a positive diagnosis be made? When the condition is well advanced, yes, but under those conditions there is no doubt in the mind of the surgeon.

It has been stated that adynamic ileus due to peritonitis is accompanied by an obscuration, as shown by the x-ray of the extra-peritoneal or subcutaneous tissue lines, normally so clearly defined in the flanks. We have not seen this proven.

The roentgenologist has already been of great aid to the surgeon in pointing out the location of the gas denoting the site of obstruction, so that the surgeon might place his incision intelligently. However, as stated before, the real problem at present is an early diagnosis. If the roentgenologist is to come again to the surgeon's aid in the matter of ileus, he must develop a means of diagnosing ileus when the patient has abdominal pain and perhaps a small amount of abnormally located gas, but before distention and persistent vomiting have developed, and before the surgeon can find the typical high-pitched tinkling peristalsis. Under such conditions, the mortality rate would drop to the level of any other type of intestinal surgery. This is obviously a high goal for the roentgenologist, but it should be accomplished.

Fig. 10.

Fig. 11.

Fig. 10. Case 9. H. C., aged 59 years, who suffered terrific epigastric pain of 48 hours' duration, not relieved by morphine. There was abdominal distention, vomiting, constipation, and decreased but high-pitched tinkling peristalsis. X-ray diagnosis was a markedly distended small intestine. The large intestine was negative to barium enema. Operative diagnosis was acute pancreatitis causing paralytic ileus.

Fig. 11. Case 10. M. A., aged 21 years, who received a trauma to the right loin. The patient suffered severe shock; there was marked distention which lasted five days. No peristalsis. Blood in urine. Peristalsis appeared on the second day. Clinical diagnosis was a ruptured kidney, giving reflex ileus. X-ray diagnosis was chiefly large intestinal distention. Also distention of some loops of the small intestine. There was a soft tissue tumor mass in the right upper quadrant.

I. Mechanical Ileus
- (*A*) External
  1. Hernias
     - (*a*) Incarcerated
     - (*b*) Strangulated
- (*B*) Internal
  1. Hernias
     - (*a*) Incarcerated
     - (*b*) Strangulated
  2. Bands
  3. Adhesions
  4. Volvulus
  5. Intussusception
  6. Neoplasm
  7. Strictures
  8. Stenosis
  9. Impactions (feces, calculi, parasitis)
  10. Retroverted gravid uterus

II. Dynamic Ileus (excessive muscular action)
- (*A*) Neurogenic
- (*B*) Tyrotoxicon poisoning
- (*C*) Lead poisoning

III. Paralytic or Adynamic Ileus
- (*A*) Reflex
  1. Biliary colic
  2. Renal colic
  3. Torsion (omental ovarian tumors)
  4. Trauma
  5. Pleurisy
- (*B*) Nerve injury or disease
  1. Spinal cord injury
  2. Cord tumors
  3. Anterior poliomyelitis
  4. Multiple sclerosis, etc.
  5. Tabitic crisis

Fig. 12.

Fig. 13.

Fig. 12. Case 11. M., adult, who was hospitalized because of tetany. There was blood calcium of 6.4 mg. per cent. A gastro-intestinal study was made because of vague abdominal distress. Symptoms were relieved by calcium therapy. Clinical diagnosis was idiopathic tetany. X-ray diagnosis was marked dilatation of the small intestine, with loss of valvulæ conniventes in the jejunum. There were multiple fluid levels in the small intestine.

Fig. 13. Case 12. L. M. suffered with puerperal psychosis. During her period in the psychopathic ward at the Philadelphia General Hospital, she developed symptoms of intestinal obstruction of a chronic nature. X-ray diagnosis was extensive gas in the intestinal tract. Numerous unidentifiable foreign bodies are shown in the film. Clinical diagnosis was intestinal obstruction. Rags, hair, stone, and paper were found to be the cause of obstruction.

(*C*) Toxic
1. Pneumonia
2. Uremia
3. Typhoid
4. Systemic infections

(*D*) Vascular
1. Strangulation
2. Mesenteric thrombosis or emboli

(*E*) Peritoneal irritation
1. Trauma of operation
2. Bacterial peritonitis
3. Bile peritonitis
4. Acute pancreatitis
5. Perforated peptic ulcer
6. Hemorrhage
7. Retroperitoneal hemorrhage or infection

(*F*) Miscellaneous
1. Low blood calcium
2. Cases without blood calcium that respond to parathormone and calcium therapy
3. Following electrical shock

EPITHELIOMA OF THE LIP[1]

By CHARLES B. WARD, M.D., *Seattle, Wash., and* ARTHUR BETTS, M.D., *Spokane, Wash.*

IT IS beyond the scope of this paper to give a complete description of every phase of epithelioma of the lip. We wish merely to emphasize a few practical points which have a definite bearing on treatment and prognosis.

We have treated a total of 228 cases of epithelioma of the lip; of these, 153 patients were treated more than three years ago. We have been unable to follow any considerable percentage of these cases for a longer period than three years: by that time they seem to have lost their fear of further trouble and fail to keep in touch with us.

It is an extremely interesting fact that epithelioma of the lip is so much more common in males than in females: 4 per cent of our cases are women. There are no negroes in this series. It is safe to assume that there is some systemic cause responsible for the more frequent occurrence in white males: no factor of irritation or habits—such as smoking—would account for the entire difference between the sexes. In recent years, women have been outdoors a great deal and smoking is rapidly increasing among them, yet the percentage of epithelioma of the lip in women has not become greater.

The immediate cause of epithelioma of the lip is a slight localized irritation frequently repeated over a long period of time. The routine examination of the lesion on the lip should include careful check-

Figs. 1-*A* and 1-*B*.

Figs. 2-*A* and 2-*B*.

Fig. 1. Case 1. This patient is 81 years of age. He has a fungating growth about 2 cm. in diameter on the left side of the lower lip. There is almost no induration. There was no history of previous treatment. Section showed cells of the mature type. There was no pearl formation. It is classified as epidermoid Grade II. Treatment: gold radon implants 9 mc.

Photograph below shows complete healing. The patient is well after three years.

Fig. 2. Case 2. This patient is 68 years of age. The upper photograph shows an ulcer measuring 5 cm. × 2 cm. on the left side of the lower lip. The margins are elevated and show marked induration. Microscopic slide shows marked pearl formation, considerable amount of fibrous tissue, and a diminished blood supply. Classified as epidermoid Grade I radioresistant. Duration, seven years. Patient had received two series of x-ray treatments during the past two years. Treatment: gold radon implants 19 mc.

The lower photograph shows the lesion healed completely. It broke down later and the patient died from extension of the growth and metastasis. I believe that radical surgery would have offered a better chance of cure in this case.

[1] Presented before the Radiological Society of North America, at the Twenty-first Annual Meeting, at Detroit, Dec. 2–6, 1935.

Figs. 3-*A* and 3-*B*. Figs. 4-*A* and 4-*B*.

Fig. 3. Case 3. The patient is 58 years of age. Duration of lesion, 18 years. The upper photograph shows an ulcer on the outer surface of the right upper lip, about 2.5 cm. in diameter, with a very hard elevated margin and a deep crater involving the entire thickness of the lip and extending from the edge of the nasal orifice downward and outward to a point about 0.5 cm. below the margin of the mucous membrane. Wassermann negative. Section showed an epidermoid Grade II radioresistant. There had been no previous therapy. Treatment: radium pack, 1 cm. distance, 6,000 mg.-hr. Duration of treatment, five days. Filtration, 0.5 mm. platinum.

The lower photograph, taken 15 months later, shows the lesion healed. Patient is free of disease but has some deformity of the upper lip.

Note the three points of difference between this case and Case 2. The lesion was slightly less radioresistant, there had been no previous x-ray treatment, and the radium pack was used instead of interstitial radiation.

(The next four cases show examples of lesions due to different types of dental irritation.)

Fig. 4. Case 4. This case gives an illustration of the most common type of dental irritation. The ulcerated area on the lower lip is about 1.5 × .5 cm. Duration of the lesion, twelve months. Section showed epidermoid Grade II.

The upper photograph shows the lesion on the lower lip and the beveled margins of the lower teeth. The lower photograph shows that the upper teeth are beveled in the opposite direction and have knife-like edges. This patient's occlusion is faulty and he will continue to sharpen his upper teeth as long as he lives: he cannot be cured of this habit. One essential part of treatment in this case is to have the patient visit the dentist every three months and have the sharp edges of the teeth smoothed off. Treatment: radium pack, three positions, 900 mg.-hr. The patient is well after five years.

ing over of the upper teeth opposite the lesion. The accompanying figures will illustrate specific types of dental irritation. In the past we have been too ready to blame general mouth infection without examining for the specific localized point of irritation. Only a small percentage of cases are due to a generalized irritation and these may have multiple lesions.

The large majority of patients are laboring men whose work involves a considerable amount of exposure; they also smoke a great deal. However, I believe that too much emphasis has been laid on smoking and exposure as causative factors in epithelioma of the lip. A dentist who has a very extensive practice tells me that he has not seen a case of epithelioma of the lip for 15 years. The reason is obvious—a large percentage of the cases of epithelioma of the lip are among men who never go to the dentist. The careful dental work

Fig. 5. Fig. 6. Fig. 7.

Fig. 5. Case 5. This patient is a fisherman, 62 years of age. The lesion near the mid-line of the lower lip is 1.5 cm. in diameter. The section showed epidermoid Grade I. There is no metastasis. This patient, like Case 4, has a tendency to sharpen his upper teeth, and the central incisors have knife-like margins which are fairly well shown in the photograph.

Fig. 6. Case 6. The patient is 43 years of age. There is a hard indurated lesion just to the right of the mid-line of the lower lip: no ulceration. Section showed Grade I. The lower right central projects forward, the upper right central also projects forward. It is ground off along the inner margin and shows an extremely sharp knife-like edge where the lower right central strikes it. The lower right central will be extracted and this patient must go to the dentist regularly to have the upper teeth taken care of.

Fig. 7. Case 7. This case is an example of dental irritation due to a very sharp partially destroyed upper tooth. There is a soft pulpy lesion on the lower lip a little more than 2 cm. in diameter. Section showed epidermoid Grade II. Opposite the lesion in the upper jaw we see that the crown of the upper left lateral has been destroyed, and there is a jagged root with an extremely sharp point. This is marked by an arrow. Treatment: radium pack and extraction of root. The patient is well after three years.

The next four cases show examples of irritation due to occupation. Cases of this type are not nearly so common as those due to dental irritation.

Figs. 8-*A* and 8-*B*. Fig. 9.

Fig. 8. Case 8. The photograph on the left shows a lesion on the upper lip about 1.3 cm. in diameter, with slightly raised, rather hard margins. Wassermann, negative. Section showed epidermoid Grade II. Patient works fairly close to a circular saw and for many years small fragments of wood and sawdust have been hitting his prominent upper lip. Treatment: Total of 800 mg.-hr. over three areas. The photograph in the center shows the after-result with the minimum amount of scarring. He is well after seven years.

Fig. 9. Case 9. The photograph shows a lesion on the lower lip just to the left of the mid-line. The upper left lateral has been removed but the teeth have no sharp edges. There is no evidence of dental irritation. The patient was a cook in a lumber camp. He gave a history of tasting hot soups and vegetables, which he did to judge the seasoning. When given a spoon and asked to show exactly how he used it, we noticed that the tip of the spoon always touched a spot on the lip just to the left of the mid-line. We attributed this lesion to the constantly repeated irritation of the hot metal spoon. During 1933 we had two other camp cooks with similar lesions.

which is being done at the present time prevents a great many cases of epithelioma of the lip. We might draw the attention of the dentists to the valuable work they are doing and urge them to prevent in every way possible the various types of dental irritation which will be described in connection with the accompanying illustrations.

All cases should have a Wassermann test and a biopsy. If the latter is negative and if syphilis has been excluded, there are three things to consider: non-malignant ulceration, granuloma, and the possibility that a mistake was made in taking the section or in examining it. In other words, a malignancy may have been overlooked. Formerly we allowed these cases with a negative biopsy to go without treatment; the usual procedure was to excise the le-

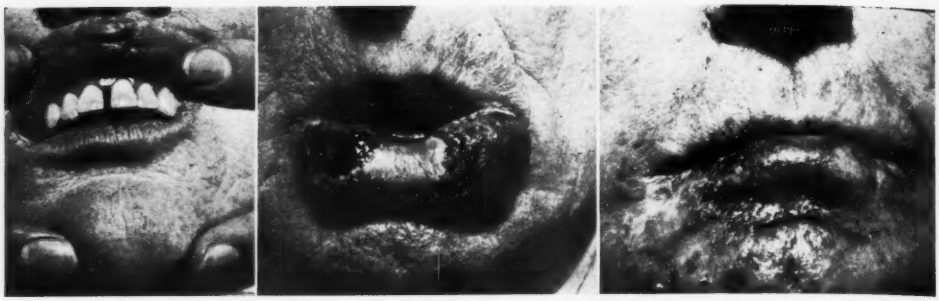

Fig. 10. Figs. 11-*A* and 11-*B*.

Fig. 10. Case 10. The photograph shows a depression on the upper lip starting almost at the mid-line and running upward and to the left. At the central part of this depression there is an indurated ulcer. The upper central incisors show a slightly irregular lower margin. Ten years ago a similar ulcer in the same location was removed, and examination by a competent pathologist showed no evidence of malignancy. The ulcer re-appeared eight years ago. Section showed epidermoid Grade II. This patient has been a seamstress for twenty years. On account of the irregular teeth and the direction of the depression in her lip, she was asked if she made a habit of biting the thread and at the same time drawing it across her upper lip with the left hand. She was sure that this was not the case but in two or three days she came in and told me that she found herself doing this all the time and that she evidently had been drawing this thread across her lip in this manner for many years.

Fig. 11. Case 13. This patient is a farmer, 78 years of age. He had a large lesion on each side of his lower lip with no extension across the mid-line. Duration, 18 months. The lesion started with a small warty nodule and increased in size rapidly the last six months. The case had no treatment up to the present time. The lesion on the left was 3 × 4 × 2 cm.; lesion on the right 3 × 2 × 2 cm. Right submaxillary gland was the size of an English walnut. There were small areas of leukoplakia inside the mouth. Biopsy from the right side showed epidermoid Grade III; from the left, epidermoid Grade II. These rapidly growing lesions were not the type which would be caused by leukoplakia.

He was treated with 3,500 r units on the right side of the lip and 3,500 r units on the left side, using a 5 cm. port and directing the rays from each side transversely across the mouth. Another 3,100 r units were given to the right submaxillary gland. After the x-ray treatments were completed, 47 mc. in gold implants were placed in the large submaxillary gland and some small ones adjacent to it. The left side of the lip showed some residual disease and 5 mc. in gold implants were placed in it: 3 mc. were placed in another residual area on the right side of the lip at the angle of the mouth.

The photograph in the center shows the lesion before treatment, with a large area of metastasis in the right submaxillary region. The photograph on the right shows the appearance three months later before the reaction had entirely subsided. Patient is free of disease now at the end of 18 months.

These multiple lesions are very interesting. Case 12 (not illustrated) is probably due to irritation throughout the whole mouth caused by leukoplakia. There is also the possibility of one or more of these lesions being due to implants. Case 13, with the large lesion on either side of the lower lip, makes one think of some systemic cause or of the possibility of one of the lesions being caused by an implant.

sion. Two of our cases showed positive sections later, one six months and one nine months afterward, indicating that a malignancy had probably been overlooked at the time of the first examination. We now give treatment to a number of these cases with negative biopsies, and, if we treat them at all, we give a full dose of radium.

All lesions up to 1.5 cm. in diameter are treated in the following manner: The radium source is 15 mm. in length, filtration 0.5 mm. platinum capsule covered with rubber so that treatment is given at a distance of 0.5 mm. Cotton is placed back of the lower lip so that the lip is everted as much as possible. Three areas are treated: the first area is on the inner surface of the lip 1 cm. from the mid-line of the lesion; the second is directly over the growth, while the third is on the outer surface of the lip 1 cm. from the mid-line of the lesion. The capsule is parallel with the alveolar margin and is held in place by adhesive. If the treatment cannot be finished in one day, it is always wise to treat the area on the inner side of the lesion the first day, as the swelling is apt to prevent full eversion of the lip. The average dose should be a total of 800 mg.-hr., 350 mg.-hr. directly over the lesion, 300 mg.-hr. 1 cm. below the lesion, and 1.50 mg.-hr. on the surface of the mucous membrane. No attempt is made to shield the mouth with lead. The lip is well everted and a cork

Figs. 12-*A* and 12-*B*. Figs. 13-*A* and 13-*B*.

Fig. 12. Case 14. This man is 58 years of age and before we started the Coutard treatment we would have turned him away as a hopeless case. Eight months before consulting us, he had been operated on, the lesion excised, and the submaxillary triangle dissected. During the last three months the lesion had advanced very rapidly with hard nodules on the skin surface and ulceration inside the cheek and lip. The upper photograph shows the condition at the time treatment was begun. He was given 200 r units daily until the total dosage was 4,600 r on the left side and 4,000 r on the right side of the jaw. The lower photograph shows the appearance four months later. He remained well for nine months and at the present time has an ulcer inside the cheek which is probably a recurrence. His improvement has been sufficient to justify the treatment.

Fig. 13. Case 15. The upper photograph shows very extensive metastasis secondary to a lesion on the upper lip two years previous. We were reluctant to advise treatment in this case but the patient insisted and was started on 200 r units daily, directing the rays transversely across the chin and neck in order that the pharynx might be spared as much as possible. He was given a total dosage of 8,100 r through three ports. The lower photograph shows the result six months later. He has not at any time been entirely free of disease, but there are only a few nodules left and he is perfectly comfortable at the present time.

Long-continued small daily doses advocated by Coutard are certainly advisable in these advanced cases. A considerable amount of palliation can be secured. If there is well marked infection, we have found treatment to be useless.

is placed between the teeth so as to avoid injury to the upper lip. The minimum dosage has been 700 mg.-hr., which gives a fairly intense reaction over a section of the lip about 3 cm. in diameter.

Patients are instructed to use lukewarm boric acid compresses three times each day for a twenty-minute period each time, followed by an application of plain white vaseline.

At the beginning of treatment the patient should be examined carefully for some form of localized irritation, which, if found, should be eliminated as far as possible.

Up until two years ago all of the patients were given fairly heavy x-ray treatment on both sides of the neck. During the last two years this has not been done and treatment has been deferred until there is definite evidence of metastasis. We are not yet sure which is the better method of pro-

cedure, but it seems more logical to treat only when metastases are present. Patients are examined every month for recurrence, and if any glands develop they are given heavy x-ray treatment on each side of the neck. In most cases, this is followed by interstitial radiation with gold implants. A few cases have had neck dissections. Occasionally patients come in with extremely extensive metastasis. The amount of infection present is the determining factor in deciding whether or not these cases should be treated. If there is a great deal of infection, we have seen no benefit from treatment, but extensive metastasis without much infection will respond very well if treated with small daily doses over a long period of time.

Even with small lesions on the lip the surgeon excises a liberal portion of tissues, and if a similar lesion is treated by radium, an area about 3 cm. in diameter should be very thoroughly irradiated. Metastatic glands treated by radiation should receive maximum dosage. Epithelioma of the lip is a serious disease and no half-way measure should be tolerated.

Radiation necrosis is an unpleasant complication after radium treatment. There are six cases in this series; three of these healed of their own accord, and, while they caused some discomfort for a time, there was no permanent deformity afterward. Each patient showed a small ulcer on the mucous membrane of the lip. The other three were more serious. One received a blow on the lip which had been treated two years before, whereupon a section of the lip about 1.5 cm. in diameter became gangrenous within the next ten days, leaving a defect which required closure by surgery later. Another man received an injury to his lower lip during the extraction of an upper cuspid. The lip was severely cut and bruised and an extensive necrosis developed, with the loss of about the same amount of tissue during the next three weeks. Both of these cases were well up to the time of injury.

The third case is interesting because of a mistake in diagnosis. A fisherman was treated with radium in 1928, and during his period of reaction he was out on the boat, beyond observation. About two years later, he developed a well marked area of radiation necrosis on the inner surface of the lip. We believed that it was malignant and gave further radium treatment without a biopsy. The patient had a great deal of discomfort following the second treatment, and I am sure now that the diagnosis of malignancy was incorrect. It was finally necessary to do a rather extensive plastic repair. It would have been much easier to do this surgery before the second radium treatment was given.

In this group, 2 per cent of the cases had serious radiation necrosis and 2 per cent had slight areas of necrosis. Radiation necrosis is bound to occur occasionally if the patients are given fairly full dosages. It is more apt to occur in interstitial radiation than when a surface applicator is used.

In this series we have included several cases which did not respond to treatment of the local lesion, but there are only two in which the lip healed and developed a local recurrence later. One of these was a dentist who received less than the minimum dosage (700 mg.-hr.). We have recently decreased the dosage on the inner surface of the lip from 300 mg.-hr. to 150 mg.-hr., because radiation necrosis has usually started on the mucous membrane.

Inasmuch as we have not been able to trace more than 50 per cent of our patients for five years, and since it has been our experience that neck metastases frequently develop after the third year, we have not thought it fair to include any percentage tables of cured cases or cases with metastasis.

SUMMARY

Attention has been called to the fact that there is some systemic cause for this disease because it is so common in white males.

The immediate cause in a great majority of cases is a strictly localized, frequently repeated irritation, usually of dental ori-

gin. The removal of this source of irritation is part of the treatment. A few cases are due to some form of irritation affecting the entire mouth.

Good dentistry plays an important rôle in preventing epithelioma of the lip.

Treatment by the radium capsule in three positions has produced the best results with a minimum amount of scarring.

Very thorough treatment is necessary in all cases.

Every effort should be made to follow the cases for a long period of time.

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TISSUE DOSAGE FROM INTERSTITIAL RADIATION

By M. C. REINHARD *and* H. L. GOLTZ, *Buffalo, N.Y.*

From the State Institute for the Study of Malignant Diseases, Buffalo, New York, Burton T. Simpson, M.D., Director

THE calculation of tissue dosage from gold radon seeds in terms of a reproducible standard or unit is essential not only that we may know the dose administered to the tumor itself, but also to the surrounding healthy tissue. This is particularly important when external radiation is applied in addition to interstitial implants.

Pending the establishment of a standard unit, we have in the past endeavored to relate the intensity from seeds (1), from intracavitary radiation (2), and from surface application of radium tubes, to the degree of reaction of the skin (erythema) produced by applying a 100-milligram tube of radium for 450 milligram-hours at a distance of one centimeter. These conditions are easily reproduced. The specifications of this tube are as follows:

Length over all	21.5 millimeter
Outside diameter	4 millimeters
Wall thickness	1 millimeter of platinum
Radiating length	19.5 millimeters

When applying this tube to the skin, a spacer of 8 millimeters of wax was used, making the distance from the center of the radium to the skin exactly one centimeter. This has been adopted provisionally as our standard.

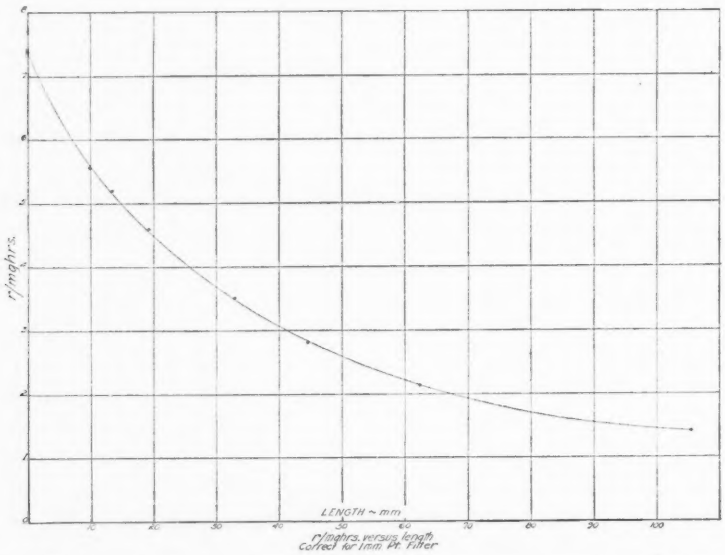

Fig. 1. Intensity curve, showing the relation between the active radiating length and the intensity in r per milligram-hour at a distance of one centimeter from the center of the radium.

The present paper is an elaboration of the previous communication on the calculation of tissue dosage from radon seeds, presenting in chart form the relation between the dose expressed in the usual terms of millicurie-hours and the previously described erythema dose, for lesions of various diameters. In addition, this paper concerns itself with the dosage and distri-

bution of radiation from needles of various active lengths as related to the above-mentioned standard.

The relation between intensity and radiating length expressed as a system of factors was published in a previous paper. Many additional measurements of radiating lengths, ranging from 10 to 100 millimeters at a distance of 1 centimeter with wax as the spacer, have been made with a different instrument, a condenser type r meter, fitted with two ionization chambers, one having a volume of 2 cubic centimeters and the other a volume of $^1/_7$ cubic centimeter. The values obtained from this series of measurements agree closely with the earlier measurements, and are shown graphically in Figure 1.

Radon Seeds.—The radon seeds in use at this Institute are 3 millimeters long, with a wall thickness or filtration of 0.3 millimeter of gold. In order to extend the curve to include this radiating length of 3 millimeters, it would be necessary to make measurements at this point. However, due to the low radon content of seeds, variation of length and possible lack of uniformity in the gold wall, it was felt that accurate measurements might not be obtainable directly. Instead, a large quantity of radium enclosed in a lead box with one side open was measured at a distance sufficiently great that the values obtained could be corrected, by means of the inverse square distance law, to one centimeter. The ionization chamber in this case was free in air, with no back-scattering, except that a thimble of bakelite, 4 millimeters wall thickness, covered the chamber. Using this measured value, the curve was completed between a point source of radiation and a source of radiation 100 millimeters long.

In spite of the several possible sources of error connected with the measurement of a single seed, several determinations were made at different times with a different seed, and the average of these measurements, 6.81 r per millicurie-hour, agrees fairly well with the value as read from the curve, when the latter is corrected from 1 millimeter of platinum to 0.3 millimeter.

From Curve I (Fig. 1) we are able to obtain the relation between the intensity of our so-called standard and any other radiating length. For instance, the intensity at 1 cm. distance of the standard (100 mg. tube, active length 19.5 millimeters) is 4.54 r per milligram-hour, whereas that of a seed 3 mm. long is 6.7 r per milligram-hour. Therefore, since the dosage as expressed in milligram-hours is inversely proportional to these intensities, and since 450 milligram-hours represents the standard erythema for a 100-milligram tube, the dose for one seed at one centimeter distance becomes 305 millicurie-hours. This is further reduced because of difference in filtration between one millimeter of platinum and 0.3 millimeter of gold to 283 millicurie-hours. Therefore, 283 millicurie-hours from one seed represents one skin erythema dose at one centimeter from that seed, or, in other words, a sphere 2 centimeters in diameter when radiated with a seed at its center, with a dose of 283 millicurie-hours, would receive one skin erythema dose at its periphery. Similarly, if we knew the relative intensity at various distances from the seed, we could express the dose at the periphery of various sized spheres in terms of skin erythema dose. Quimby has pointed out that, when seeds are distributed within the inner half of a sphere, the relative amount of radiation reaching the periphery or distances beyond this boundary decreases as though the radium were concentrated in one seed located at the center of the sphere. A knowledge of the distribution of radiation around one seed, then, will enable us to estimate the dosage at any point in terms of a standard skin erythema dose.[1]

Intensity measurements were, therefore, made with a Victoreen condenser type r meter at 1, 2, 3, and 4 centimeters from the seed, using wax as the absorbing material. For greater distances, because of the low radon content of one seed, it was necessary

[1] No allowance has been made for the difference in time of application of the tube and seed, or to the depreciation of the radon. This will be considered in a subsequent publication.

TABLE I.—DOSES IN MILLICURIE-HOURS DELIVERED TO MASSES OF VARIOUS DIAMETERS BY GOLD SEEDS

S.E.D.

	1	2	3	4	
Diam. (cm.)					
1	60.2	120.4	181	241	310
1.5	156	312	468	624	780
2.0	283	566	849	1,132	1,415
2.5	480	960	1,440	1,920	2,400
3.0	698	1,396	2,094	2,792	3,490
3.5	936	1,892	2,808	3,744	4,680
4.0	1,195	2,390	3,885	4,780	5,975
4.5	1,530	3,060	4,590	6,120	7,650
5.0	1,872	3,744	5,616	7,488	9,350
5.5	2,222	4,444	6,666	8,888	11,100
6.0	2,620	5,240	7,860	10,480	13,100

TABLE II.—MILLICURIES IN GOLD SEEDS TO DELIVER SPECIFIED DOSES TO MASSES OF VARIOUS DIAMETERS

S.E.D.

	1	2	3	4	5
Diam. (cm.)					
1	.45	.9	1.3	1.8	2.2
1.5	1.2	2.3	3.5	4.7	5.8
2.0	2.1	4.2	6.3	8.4	10.5
2.5	3.6	7.2	10.8	14.4	19.0
3.0	5.2	10.5	15.8	21.0	26.2
3.5	7.0	14.1	21.1	28.1	35.1
4.0	9.0	18.0	27.0	36.0	45.0
4.5	11.5	23.0	34.5	46.0	58.0
5.0	14.1	28.2	42.3	56.0	71.0
5.5	16.7	33.0	50.0	67.0	84.0
6.0	19.7	39.0	59.0	79.0	99.0

to resort to the values obtained by extrapolating depth intensity measurements, as indicated in a previous work (1), and remeasured for the present paper. (See Figure 2.) These curves also enable us to determine the intensity at any depth from applicators of various lengths up to 105.5 millimeters.

Using 283 millicurie-hours as one skin erythema dose for one seed at a distance of 1 centimeter, or, in other words, for a sphere 2 centimeters in diameter, plus the values obtained from Figure 2, the values in Table I were calculated to indicate the relation between millicurie-hours and diameter of part radiated in terms of the skin erythema dose. Such a table is particularly useful to determine the dosage in terms of skin erythema dose at various distances from a tumor which has been implanted with gold seeds and the total dose in millicurie-hours known.

Martin and Quimby (3) have published a very satisfactory seeding chart, enabling

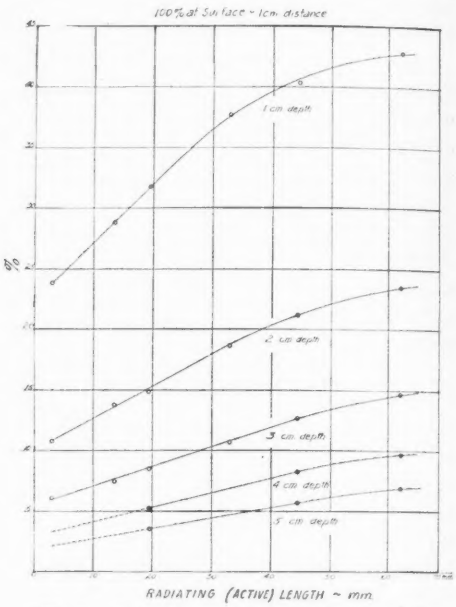

Fig. 2. Intensity curves, showing the relative intensity one to five centimeters from various active radiating lengths; 100 per cent at the surface, which is one centimeter from the center of the radium.

TABLE III.—RELATION BETWEEN LENGTH OF RADIATING SOURCE, INTENSITY, AND DOSE TO PRODUCE ONE S.E.D. AT ONE CENTIMETER DISTANCE

Length

	10 mm.	15 mm.	20 mm.	30 mm.	40 mm.	50 mm.	60 mm.
Int. r/mg.-hr. 1 cm. from needles	5.83	5.2	4.68	3.86	3.2	2.7	2.31
Dose mg.-hr.	350	393	436	528	638	757	884
Int. at Depth							
0	100%	100%	100%	100%	100%	100%	100%
1 cm.	27.2	29.6	32.0	36.4	39.6	41.6	42.7
2 cm.	12.6	14.0	15.3	18.0	20.3	22.1	23.3
3 cm.	7.1	7.9	8.7	10.3	11.9	13.4	14.5
4 cm.	4.1	4.7	5.3	6.5	7.7	8.9	9.6
5 cm.	2.7	3.2	3.6	4.5	5.3	6.2	6.8

The relative depth intensities refer to 100 per cent at one centimeter from the needles.

one to select the number of millicuries required to radiate tumors of various diameters, in terms of threshold erythema doses. We have expressed the material in Table I in this manner, but related to our skin erythema dose previously described instead of the threshold erythema dose. (See Table II.)

Radium Needles.—The application of Figures 1 and 2 to the problem presented by radium needles is accomplished in a manner similar to the example described above for seeds. Thus, the relation may be obtained between radiating length of the needle and that of the standard tube, and the distribution of radiation around any length needle at distances from one to six centimeters. This material as assembled from Curves I and II is shown in tabular form (Table III).

SUMMARY

Ionization measurements have been conducted to show the relation between the intensity at one centimeter distance and the radiating length from a point source to 100 millimeters, and also to determine the relative depth dose for applicators of various lengths. Based on these measurements, calculations have been made and are presented in a table, making it possible to estimate the dosage in terms of skin erythema which has been delivered by radon seeds to masses of various diameters. A table arranged in a manner similar to Quimby's is also presented, which permits of a selection of the number of millicuries required to radiate spheres of various diameters

A table based on the above-mentioned measurements is presented, expressing the relation between the intensity and dosage under standard reproducible conditions and that for radium needles of various lengths. Intensity tables are also given for various needles.

BIBLIOGRAPHY

(1) REINHARD, M. C., and GOLTZ, H. L.: Calculation of Dosage from Radon Seeds. Am. Jour. Cancer, 1933, **17,** 770.

(2) IDEM: Calculation of Dosage from Intracavitary Radiation. Am. Jour. Cancer, 1933, **17,** 757.

(3) MARTIN, H. E., and QUIMBY, E. H.: Calculation of Tissue Dosage in Radiation Therapy. Am. Jour. Roentgenol. and Rad. Ther., 1930, **23,** 173.

SOME LAWSUITS I HAVE MET AND SOME OF THE LESSONS TO BE LEARNED FROM THEM[1]

(*Seventh Installment*)

By I. S. TROSTLER, M.D., F.A.C.R., F.A.C.P., *Chicago*

A MOST BIZARRE AND UNIQUE SITUATION

What is beyond question the most bizarre and unique affair among my experiences with medico-legal matters is explained in the following letters.

"My Dear Tros: I am in a Hellova mess. An E.E.N. & T. specialist, who is a very close personal friend and who refers a considerable amount of work to me, broke a tonsil knife while doing a tonsillectomy in a cantankerous female woman, about two years ago. Being unable to find the knife blade, he said nothing and left it there—in the patient's peritonsillar region.

"Three months ago this same patient (the c.f.w.) was sent to me for a chest examination by one of our best internists. My technician made a stereo pair which incidentally showed the lower jaw and neck and disclosed the fragment of the knife.

"The internist who sent this c.f.w. always studies the films of his patients, in my office, and saw the shadow of the knife. He asked me what the shadow indicated. Suspecting what it was, and knowing nothing of the incident, I was reluctant to say; but I was practically forced to tell the internist that it looked like a piece of metal, probably a fragment of a tonsil knife, in the peritonsillar region.

"The internist told the patient (the c.f.w.) that she had a piece of a knife in her throat and, of course, she immediately proceeded to raise Shoel with the E.E.N. & T. man, who, in turn, came to me. While the latter does not in any way blame me, and it is quite obvious that the piece of metal in her throat is doing no harm to the patient, there is very little doubt but that a malpractice suit will soon be started. And all because my x-ray films show the piece of that blamed knife.

"What can I do? If I destroy the films, they will have others made, while if I keep them I will probably have to produce them in court and testify against my friend. What do you advise?"

I replied as follows: "My Dear M—, replying to yours of recent date will say that your dilemma is certainly the most bizarre and embarrassing situation that I have ever heard of.

"While it is bad enough to have disclosed the presence of the foreign body, it seems to me that it would be worse to have to testify in the case, if suit is brought, because it would appear as though you were helping to prosecute a malpractice suit against your friend.

"I want you to understand distinctly that I am not advising you to destroy the films, but if your technician or some one would leave those films in an unusual place and they would consequently become lost so that you would not be able to produce them in court, you would not be compelled to testify as to what they showed. There are several decisions from your own State and other State supreme courts, that testimony regarding what are shown in roentgenograms may not be introduced unless the roentgenograms are also introduced in evidence.

"If that woman wants you to make more films, you may be unable to do it for her, because the machinery is out of order, or for some other good reason, and she might have to go elsewhere for the subsequent examination. That might let you out of a part of your trouble.

"You did not give me the date of the operation on the tonsils. If it was more than two years ago, the limitation has expired, as two years is the limit for action in torts (or civil wrongs) in your State.

"Also, if the operation was performed in an eleemosynary institution and the

[1] The Editor desires to state that much of the matter herein has to be printed in form as received, without normal punctuation or phrasing.

knife was defective—as it certainly must have been—quite a good fight or defense might be developed along those lines. The surgeon who used the knife would hardly be held responsible for the defective knife and the hospital being a charity institution could not be held.

"Personally, I would say that if the matter can be settled out of court, it would be the best way to dispose of it."

The final outcome of this peculiar situation was that no suit was filed. The attorney for the otolaryngologist settled the case for three hundred dollars. It was settled for this small sum because the limitation had expired and the otolaryngologist preferred to pay that amount rather than have the publicity which probably would have resulted if suit had been started.

The foregoing shows how a combination of circumstances may stir a mess that the wisest of us either in medicine or law are put to our wits' ends to untangle. We do not know what the next day has in store for us, in the way of a malpractice suit. The best of our professional brethern are liable to have the ill fortune to have to combat such a suit, so it behooves all of us to stand ready to "go the limit" to defeat all of these cases.

FAILURE TO EXAMINE SKIN IN TREATED AREA IS A SERIOUS ERROR

In 1930 a physician in an east-central State wrote to a local colleague relative to a suit. The latter asked me to take over the matter in his stead. I wrote as follows:

"Dear Doctor Q—: Your letter of June 28 to Dr. — of this city has been referred to me because he somehow has gained the impression that I have had more experience and have a greater fund of information regarding the matter you mention in your letter.

"I will try to answer your questions in the order that they were asked.

"'In the case of an x-ray burn, how long does it take to become manifest?' Six days to two years.

"'May a case go for several months before it is recognized? Is there any rule in such a condition?' Yes, a case may go for several months before it is recognized. That is what we call a delayed reaction and usually when it does occur it follows several repeated applications of the rays. There is no rule that I know of in such a condition.

"'Can you cite me any cases that did not show up for several months?' I can, several, but it seems to me that there is no need for same.

"'Can you give me the name of some reliable authors who mention this subject?' MacKee, *X-ray and Radium Treatment of Diseases of the Skin*, published by Lea & Febiger. If you cannot buy it in your city, I will be glad to have the Chicago Medical Book Co. send it to you.

"You state that you are 'accused of burning a patient, but learned that she was treated by another physician who uses the x-ray,' and that you treated this patient before and after the other man treated her. It is most advisable for you to have evidence that the other man did treat this patient, if, at the time of the trial (if it does come to trial), the limitation has expired for the other man, thus making little doubt that this other man will be willing to testify for you.

"The information you give in your letter is rather meager, so that I am unable to give you much advice which might be of value. I wonder if you would care to give me the full particulars regarding dates, dosage applied, etc. Have you insurance against malpractice suits? If so, in what company?

"I am frequently called upon to help in the planning of the defense of malpractice suits involving so-called x-ray burns, and as an expert witness to establish the correctness of the technic, etc."

The foregoing letter led to the insurance carrier sending me the particulars of the case, copy of plaintiff's preliminary affidavit, etc. After going over these, I wrote the insurance carrier at considerable length, as follows:

"Yours of July 9 with enclosures relative

to above case to hand. I also have letters and copy of record of the technic used, from the defendant (in his own handwriting).

"Reviewing the entire matter from the material in my hands, will say that as far as I can determine, the only defect and error on the part of the defendant in this case as regards his treatment, etc., is the failure to examine the bare skin of the patient (plaintiff) on the area to be treated, for the presence of redness, etc., each time that the treatment was administered. But the curse of this is in a great measure removed and set off by the repeated statements of the plaintiff in her deposition, that she examined that region herself and told the defendant that it was not red. The intervals between the treatments were correct and proper for the conservation of the skin as much as possible and to produce the desired effect upon the cancer of the colon, with the voltage (S.G.) used. The filtration used was correct and proper for the voltage. The time was not excessive. The dosage applied was very, very conservative.

"The technic given to me by defendant under date of July 1 is as follows:

"Filter, 5 aluminum (I take it to mean 5 mm.) and sole leather attached to board;
Distance, 25 in.;
Current, $4^1/_2$ mil. (I take that to mean $4^1/_2$ milliamperes);
Time, $4^1/_2$ minutes;
Gap, 8 in.

"The technic given in his statement to you on the printed form, Sec. 10, is—

"Filter, 5 mil. (which I take to mean 5 mm.) and 1 sole leather (meaning one thickness, or about 5 mm.);
Voltage (S.G.), 6 in.;
Ma., $4^1/_2$;
Distance, 25 in.;
Time, $4^1/_2$ minutes.

"You will note that he wrote me '8 inches spark gap' and to you he wrote '6 inches spark gap.'

"The technic as given to me (8-inch spark gap) produces about $^1/_{20}$ E.S.D. (erythema skin dose) for each application or treatment and is a very safe dosage to apply even daily for a considerable time. As only twenty-three of these doses were applied by defendant over the period of twenty-six months, and at two-week intervals, it is inconceivable that she was overdosed by him.

"Aside from and in addition to the above, if an indurated edematous or chronic indurated dermatitis, with subsequent superficial breakdown, did occur as alleged, this effect would be incomparably more desirable than to permit the continuance of the cancerous growth in her colon, with absolute certainty of a lingering, miserable, excruciating death.

"The fact that plaintiff received three treatments from another man (Dr. N— of U.), may have considerable to do with your defense of this case (but in all likelihood it had little or nothing to do with the alleged injury). The fact that another man treated her should, of course, be played up in the defense of the case. In fact, the results of Dr. N—'s treatment, if he administered sufficient to produce injury or do damage, such injury or damage might not appear for six months or longer, due to what we call a delayed reaction, and as *we know* what the defendant in this case administered and that it would not produce the effect plaintiff alleges she had, it is reasonable to suppose that the affect alleged by plaintiff—if it did occur—was produced by the treatments administered by Dr. N—.

"Attorney H—, in the last paragraph of page 2 of his communication to you of June 3, 1930, said: 'It seems to me the big question in this case is whether the present burn is the accumulation of more than one improper treatment and how long after one or more improper treatments would such a condition develop and first show a burn with the following consequences. . . .' That idea is good, very good, but I think it can be better developed by assuming that the three treatments given by Dr. N— may have been sufficient to have augmented the proper dosage of defendant's previous

treatments, and then more, perfectly proper, subsequent treatments and a delayed reaction (which is not at all rare) have produced the effect alleged and complained of by the plaintiff in the case.

"If the roentgenograms made by the defendant for diagnostic purposes can be found, and I believe he states that he has them, it will be very valuable to have them introduced in the case as evidence to show that the plaintiff had cancer and that, having cancer, most vigorous treatment up to the point of producing a local skin injury (which might be later removed if desirable or necessary) would be far preferable to allowing the cancer, which was diagnosed by these films to be inoperable, to destroy the life of the patient.

"If the aforementioned roentgenograms do definitely, or even indefinitely, show an obstructive tumor and these roentgenograms can be submitted to proper expert witnesses for examination, and the expert gives an opinion regarding prognosis—length of life of patient—if not treated, the idea of this being to establish evidence that her life had been prolonged by the treatment as given and the effect that this might have on the jury, and possibly help win the case. It is my opinion that the dermatitis alleged to have resulted in this case and for which plaintiff is alleged to have been operated on, was not the result of improper technic, neglect, ignorance, trespass, or other treatment chargeable as malpractice on the part of the defendant in this case. The changes in the tissues on the plaintiff's abdomen may appear in from two months to two years after the treatment (even proper treatment), and may be due to natural and unavoidable effects which follow irradiation, because of the conditions produced in the tissues about and adjoining the diseased area which is being treated. It was, in my opinion, not an acute dermatitis such as is implied by the term x-ray burn, but was an indurated, edematous condition of the skin and underlying tissues, which broke down due to the lack of blood supply, this lack of blood supply being induced by the obliterative endarteritis resulting from the repeated irradiation.

"Glancing through the deposition of the plaintiff, I note that she contradicts herself (on page 6): 'Mrs. D—, what position did you occupy when the treatments were given you? *Ans.* I was turned in this shape [half on her side]. *Q.* You were lying on the table? *Ans.* Yes. *Q.* Did you always keep the same position on the table when the x-ray treatments were given? *Ans.* I was always lying on my back when the treatments were made.' While this may be unimportant, it shows her unreliability and may be used to show the jury that she does not always tell the same story.

"Patient gave the time of the treatments as twenty-one minutes on page 14 of her deposition, but, of course, that is only a guess.

"Regarding the redness and line of swelling described by the plaintiff, will say that it is my opinion that this *did not come on, appear, or develop between 4* P.M. *and 9* P.M., *on Jan. 18, 1930.* There had been no examination at 4 P.M. when the treatment was given and in all likelihood for days before, and the time it was first seen (five hours after the last treatment) was only accidental and incidental, and had no relation to the time of the last treatment or the administration of that treatment except that this last treatment was adding insult to injury. The damage, if any, had been done long before the last few treatments. Any redness which might occur five hours after the administration of a treatment would not be due to the x-rays *per se*, but might be due to static electricity producing a localized dilatation of the superficial blood vessels, and the consequent blushing or erythema. This phenomenon is aptly described as an 'electric erythema' on page 313 of MacKee's 'X-rays and Radium,' second (1827) edition.

"Idiosyncrasy or hypersensitiveness cannot be used nor be considered as of use as a defense in this case because there was no unusual effect produced by the roentgen treatments until after the last treatment,

which was twenty-six months after the beginning of the treatments.

"Accumulation of the dosage cannot be proven if charged by plaintiff, as 50 per cent of the dosage is supposed to be lost from the tissues in about ten and one-half days, as shown by Kingery, and from the records of the treatment in this case, at no time was the dosage more than $^1/_{20}$ of an E.S.D. as given to me by Dr. Q—, and very much less from the figures given to you.

"It is my opinion that there should be little difficulty in securing a favorable verdict in this case. I am prepared to testify to the facts as given by me as my opinion:

First, that the treatment as given by the defendant could not possibly produce the effect complained of and alleged by plaintiff;

Second, that the treatment was proper;

Third, that the effect complained of by the plaintiff might have been, and probably was, produced by the three treatments administered during the Summer of 1929 by Dr. N—;

Fourth, that the plaintiff would probably be dead at this time if she had not had the x-ray treatments described as being administered by Dr. Q—, and

Fifth, I am prepared to interpret x-ray film made by Dr. Q— if it shows an obstructive lesion as cancer, if it is cancer, and give such other testimony and opinion as may be developed therefrom."

After further unimportant correspondence I wrote the insurance carrier: "Yours of July 15 with copy of P. & S. report of Dr. N— received and noted.

"In reply to question 27 on the P. & S. report Dr. N— states, 'Dr. D. S. Q—, of . . ., was treating this woman with x-rays for fibrosis of the uterus—so she told me. . . . After examination of the abdomen I gave her one treatment June 17, 1929, and another on July 17, 1929.'

"Two things in the foregoing quotation do not agree with either Dr. Q—'s (defendant) or Mrs. D—'s (plaintiff) statements and because of the latter's statement to Dr. N— that she 'was being treated for fibrosis of the uterus,' when, as a matter of fact and record, she was being treated for tumor (cancer) of the colon. *May not this statement be used*, or found to be useful in the defense, to break down the credibility of the testimony of the plaintiff? It certainly shows that her statements are not to be relied upon, that she varies from the truth, and if these facts and statements can be introduced, it cannot help but lessen the effect of her testimony upon the jury. In her deposition, plaintiff repeatedly mentions that three treatments were administered by Dr. N—. Also, this is another instance where she varies from the actual records and, of course, should be used to break down her credibility.

"In the technic described by Dr. N—, 120 kv. p. equals 7.81 inches between blunt points, but with the ordinary blunt points used in the Victor-Snook machine, this is equal to about an 8-inch spark gap. The dosage produced by that voltage, 5 ma., 5 minutes, 18-inch F.S.D., and 3 mm. aluminium filter equals about $^1/_8$ E.S.D. Two of these treatments administered at thirty-day intervals are entirely within safe limits; in fact, I would not hesitate to give eight times as much, either considering or not considering the treatment applied before or after that time, by Dr. Q—.

"As far as I can see, the aspect of the case has not been changed by anything given in this statement of Dr. N—, except to further discredit the plaintiff, and in my opinion there should be little difficulty in securing a verdict of 'not guilty' for the defendant physicians."

About one week later I received a letter from the law department of the insurance carrier, reading as follows: "We are in receipt of your letter of July 16. We agree with you that the contradictory statements made by Mrs. D— in her statement to Dr. N— and her deposition will affect her credibility as a witness which undoubtedly will have quite an effect on a jury and a reaction should be in favor of the defendant. Because of the previous contradictory statements made by Mrs. D—, it is quite

likely that she will make more contradictory statements when she testifies in the case, which will be in our favor.

"We are pleased to learn that in your opinion the treatments given by Dr. N— are entirely within the safe limits. We, therefore, anticipate that if the case goes to trial, the verdict should be in his favor. As we now look at the case there is only one danger, and that is Dr. Q—'s failure to make examination of the skin of the plaintiff before the last treatment was given. Plaintiff, in her deposition, has removed a great deal of this danger because of her testifying that there was no reaction until the last treatment. If she will affirm this statement when she testifies at the trial, the verdict should be in favor of the defendant because we have a good defense to all the other allegations of negligence."

This suit was tried about six months later and a judgment was given to the plaintiff, with damages in the amount of $5,224. I was sorry not to have been called to testify. It was settled for $5,000.

Just as was stated in the last letter from the law department of the insurance carrier, the great danger lay in the defendant not having examined the skin of the treated area before administering the last treatment. Apparently that was the crucial point that turned the tide against the defendant.

The main and principal lesson to be learned from this lawsuit is that we should examine the skin of the area about to be treated *every time*, and not even leave that examination to our assistants or technicians. Had the defendant in the foregoing case done that, I feel sure that the jury would have found for him instead of for the plaintiff. Personally the writer has not failed for the last thirty years to examine the skin of a patient about to be treated, and would no more think of treating a patient without first studying the skin of the area to be treated than he would fail to make sure to ascertain what filter is under the tube. We know that this seems trivial to the careful men, but it is reiterated for the benefit of those not so sure and careful. They are the ones who need and should heed it—*experte credite*.

The foregoing case reminds the writer of a somewhat celebrated Tennessee case,[2] in which, after 161 applications of the roentgen rays, a dermatitis appeared. Testimony brought out during the trial showed that the physician had failed to examine the skin of the treated area before the last treatments. While we, of course, have reason to assume that the application of 161 roentgen treatments was the most likely cause of the injury, the legal aspect of failure to examine the skin of the area treated was the most decisive feature and the reason for the decision and confirmation of the judgment of the trial court by the Supreme Court.

POMPOUS, PONDEROUS PHRASEOLOGY PLACES PLATITUDINOUS PLANS POSTERIORLY

There are times when attorneys use every effort to show their learning, particularly as regards their use of big words, lengthy phrases, and high-sounding bunk. At such times as these, it has been the greatest of sport and pleasure for me to display as much of the same sort of verbosity, and employ similar tactics to those of the learned counsel, even to the extent of coining new words in the answers to long, but usually meaningless questions.

Not long ago, I was called into court as an expert witness by the plaintiff in a personal injury case, and after being qualified as a physician specializing in radiology, I presented, identified, and described the findings in the roentgenograms.

Upon being asked if I had made a physical examination of the woman plaintiff, I replied that I had, and was directed to describe fully and in detail all my findings. After this the following hypothetical question was prepounded to me:

"Assume, Doctor, that a woman of the size, age, weight, and general appearance of the plaintiff in this case was riding upon a seat in the middle part of a passenger railway coach, which was the fourth car

[2] Lewis *vs.* Casenburg, 7 S. W. R. (2nd), 808.

behind the locomotive, there being a refrigerator car, a baggage car, and an express and mail car ahead of the passenger coach containing this passenger. Assume further that while this train was made up of the three cars and the passenger coach just described and three day coaches, a chair car, and two sleeping cars behind the coach where this passenger was seated, was moving at the rate of about forty-five miles an hour in a southwesterly direction and another train on a track at right-angles to the just described train in which this woman was riding, and moving at the rate of about fifty miles an hour in a southeasterly direction collided with the first mentioned train which was moving at the rate of forty-five miles an hour in a southwesterly direction, the locomotive of the second train colliding with the first train at a point one passenger coach behind the coach where the woman was riding, causing the coach that was struck to be turned upon its side. Assume further, Doctor, that the woman in question was removed from the overturned coach and taken to a hospital in an ambulance, about two hours after the collision in an unconscious condition and that she did not regain consciousness for three hours afterward, and that she was excited and screaming for a period of over an hour after she had regained consciousness. Now assuming all the foregoing, have you an opinion as to whether the railroad collision just described would be sufficient to cause and produce the fractures, injuries, wounds, contusions, and bruises you mentioned and described having found upon the head, body, and limbs of the plaintiff in this case?"

Defendant's attorneys objected to witness answering the question just quoted because he had qualified as a specialist in radiology. The judge very pompously asked the writer if, being a physician, specializing in radiology qualified him to answer the question, and upon being answered in the affirmative, said, "Witness may answer."

I answered, "I have an opinion," and when asked, "What is that opinion?" I replied, "Such an accident might cause or produce any degree of injury ranging from a mere scratch to instantaneous death."

Defendant's attorneys objected to my answer as "not responsive to the question," and asked that it be stricken from the records. "Motion to strike is granted," quoth His Honor.

"Now will you answer the question again, Doctor?" Being thoroughly disgusted with the haggling, the complaisance of the sitting judge, the attorneys for both sides, and all concerned, I asked that the question be repeated—merely as a subterfuge to give me time to think—and when the stenographer had finished reading the question I replied, "It is my opinion, based upon something over thirty years of medical practice, and the examination and study of thousands of patients, that the collision of the two trains described in the hypothetical question just propounded to me, would be sufficient to cause and produce the fractures, injuries, bruises, contusions, and abrasions which I found upon the head, body, and limbs of the woman I examined and whom I presume is the plaintiff in this case."[3]

I was dismissed, without cross-examination, much to the apparent satisfaction of all, including myself. Here was an instance of the attorneys on both sides of a case using every effort to be ponderously technical, and I cannot suppress a chuckle at my being able to be as technically banal as they and in that way making them anxious and glad to get rid of me.

While I fully realize that my own conduct was reprehensible and not to be recommended or advised to physicians or other expert witnesses, I cannot suppress a feeling of considerable satisfaction over having been able to contribute my share of technically worded answers to the pompous group. Of course, I realize that I, personally, was not the target the lawyers were aiming at, nevertheless my satisfaction was and is just as keen as though I had been their target.

[3] My thanks are due to the court reporter for a verbatim transcript of my testimony in this case.

THE ATTORNEY WAS HONEST BUT HIS CLIENT WAS NOT

Miss X—, a slight, thin, small, young woman, who according to my record weighed 106 pounds, claimed to have been injured early in March, 1921, and was examined by me roentgenographically March 19, 1921, for an alleged costal and thoracic spinal injury, with negative results.

Because of the negative results of my examination, I carefully marked the films for identification and delivered them to her attending physician, along with my report stating that the regions examined showed no roentgen evidence of fracture, dislocation, defect, anomaly, or deformity.

I heard nothing further of this case and in the meantime her physician had moved to a distant part of this country; but on January 14, 1923, I was served with a *subpoena deuces tecum* to appear with the roentgenograms in the Superior Court of Cook County and to testify in the case of Miss X— *vs.* the Chicago T.M. I appeared, as ordered, with the carbon copy of my report annotated that I had delivered the films in the case to Dr. A— on March 22, 1921. Not having the roentgenograms, I was permitted to testify—*against the objections of both sides of the case*—as to what my findings were. I was then handed two roentgenograms and was asked to interpret them.

It was immediately evident to me that the two roentgenograms which I was asked to interpret were made from a much larger and heavier woman than the woman I had examined, and that an effort to introduce these as being made of her, was being made. After taking several minutes to revolve this matter in my mind, taking so long that I could see that all concerned were growing impatient at my delay, I said, "The two roentgenograms or x-ray films which I hold in my hands, marked plaintiff's exhibits A and B, are x-ray representations of a moderately stout woman, with large heavy breasts and considerable fat or adipose tissue, who apparently has a lobar pneumonia in the lower lobe of the right lung."

When I had reached that point in my description both the trial attorney for the plaintiff and the judge halted me, the first with an objection, the judge with "Just a minute, Doctor," while the attorney for the defendant arose and grinned as though he had just heard a very funny story.

The plaintiff's attorney took the films from my hands and examined them for the marks of identification which had been placed there by the court stenographer, and at the judge's request handed them to him (the judge), who, finding the identifying marks correct, returned the films to me. The judge then asked me if I had made those films, to which I replied in the negative. Asked if I had ever seen those films before, I again said, "No." He then asked me if I had an opinion as to whether the films in my hands—marked plaintiff's exhibits A and B—were roentgenograms of Miss X—, pointing her out as she was seated at the plaintiff's side of the long table, to which I replied that I had. Plaintiff's attorney objected to my answer and to my giving such an opinion because he thought that my answer would be a guess. The judge then asked me if my answer would or might be a guess, and upon my reply that it would not be a guess, he directed me to state if in my opinion the x-ray films in my hands were made from the plaintiff in this case. I answered, "It is my opinion that the films in my hands were not made from the young woman seated at the left side of the table—if she is the plaintiff in this case. They were not made from her, because the films in my hands were made from a very much larger and very much heavier woman."

The attorney for the plaintiff immediately moved that my answer be stricken from the record as not responsive to the question, etc., but the judge remarked that the doctor having been qualified as an expert, his opinions on this and similar points were competent, and that the answer would stand in the record. At this time the judge called for a five-minute recess, asking that the attorneys see him in his chambers for a conference.

The attorney for the defendant rushed up to me and said, "Doctor, we are going to call you as our witness, if this case continues."

After a few minutes, the judge and the attorneys returned to the court room and the attorney for the plaintiff asked permission to withdraw from the case. While the judge was considering this, one of the attorneys for the defendant asked permission to move that the case be dismissed. After consulting his client, the attorney for the plaintiff agreed that it should be dismissed, which was accordingly done.

Here was an attempt to perpetrate a fraud by introducing roentgenograms of another woman showing three fractured ribs and a lobar pneumonia, which I had discovered, and prevented. This could, of course, have been done by any one at all familiar with roentgenograms.

The attorney for the plaintiff claimed that he did not know that the films given him were spurious, and insisted that he had been innocently led to believe that his client had suffered broken ribs, and had called me as the roentgenologist who had examined his patient.

The two films were later sent to me by the judge, in whose court they were left, along with a short note thanking me for my perspicuity, and suggesting that I might be the one most interested in them. A careful search revealed absolutely no identifying marks upon the films, except the pencil marks of the court reporter, consequently it was impossible to determine by whom or where they were made.

This quite evident attempt to mulct a big corporation failed because of the ignorance of the plaintiff and because her attorney did not know that the films she presented were fraudulently submitted. I do not believe that the attorney for the plaintiff was at all guilty of any fraud or trickery, and I am likewise sure that the judge before whom this case came up believed him innocent or he would have done something in the matter.

Incidentally, the woman plaintiff in the foregoing case was killed several years ago, in an automobile accident, while in company with a rather notorious gangster.

A FAKE ACCIDENTAL INJURY CASE

In 1928, a man alleged to be practising medicine without a license—applied to an insurance company wherein he was carrying an accident insurance contract, asking the insurance company to pay him indemnity for an injury which he claimed to have occurred when he bumped his ankle against the transmission lever of his automobile.

He submitted two roentgenograms, showing fractures of the fibula, at the time of his application for indemnity. On account of his having once before presented a rather amphibolic and suspiciously dubious injury claim, the adjusting division of the insurance company sent him to their examining physician. The latter, in turn, referred him to me for roentgen examination of the injured ankle, at the same time sending the two roentgenograms presented by the claimant, for comparison with those I was to make.

In my report to the examining physician of the insurance company, I stated: "There is no roentgen evidence of fracture, dislocation, defect, deformity, anomaly, or disease in the region examined. The two roentgenograms submitted by the claimant show simple diagonal fractures of the left tibiæ at different angles and in different places, and are made from two different individuals, neither of them from the man I examined."

After several weeks the claimant threatened to sue the insurance company. One of the claim adjusters advised him to see me before starting suit. He filed the suit—or rather his attorney did—and later visited me, at that time making advances to have me do his roentgen diagnoses for him; but I received his advances in so chilly a manner that he withdrew in confusion when I read him the carbon copy of my report regarding his alleged ankle injury.

I later learned that he was sent to Leavenworth because of his misuse of, or sale of, narcotics, and that he had previously had his liquor permit taken from him. The

suit for indemnity was withdrawn by his attorney when he learned the contents of my report.

The two preceding instances of efforts to use roentgenograms in a fraudulent manner are the only ones with which the writer has knowingly been brought into contact, although suspicious cases of similar conduct have occurred a few other times. It probably occurs more often than we know, and the perpetrators get away with it, or it would not be tried.

BRIBERY! (HOW AN ATTEMPT TO BUY ROENTGENOGRAMS WORKED OUT)

Several years ago a medical friend was rather severely smashed up by being struck by the automobile owned and driven by a wealthy sportsman and playboy. The report of my roentgen examination stated that there were two fractured ribs, a fractured clavicle, a fractured humerus, and fractures of both bones of his left forearm.

After several weeks' stay in a hospital the injured man was offered $800 in settlement, by an attorney who said he represented the owner of the speeding automobile that had caused the injuries. This the injured man refused. A few days later the same attorney called upon me and asked to see the films of the injured man. When shown them he gathered them up and said that he would take them to show to his medical advisor, and I had to stand between him and the door to take them away from him. He protested that he would return the films to me; but I was not going to be fooled by so flimsy a scheme and told him that he could send his man to me and I would show them to him. I informed this attorney that under no circumstances would I allow the films to leave my possession, no matter what he said or promised.

Months passed without any further word from the man who owned the automobile, and finally my friend employed an attorney, who filed suit for $25,000 damages. After several years of continuances and postponements, in a measure due to the overcrowded condition of the dockets of our courts, I was called on the telephone by the same attorney who was acting for the defendant, and made an appointment for him to see me in my office. Before his arrival at my office, I directed my secretary to stay in the next room and to take down every word of the conversation.

The attorney arrived at the appointed time, and, glancing around my office, was evidently pleased to find me (apparently) alone. He very promptly came to the point of his business by asking me if I still had the "x-ray films in that case of Dr. S—." Upon being told that I had them in my files, he asked to see them. I declined to show them to him, after reminding him that he had previously seen them, but offered to let him see the copy of my report in the case, which I did.

After a little verbal sparring, he exposed his hand by asking me how much I would sell him the films for, and when I replied, "I do not know," he offered me $250 for them. I then asked him if he would pay that much in cash, to which he replied, "Yes, spot cash," and drew out his wallet as though to show me the money. I then said, "No, Mr. X—, I will not accept your offer. Miss C—, you can come in now," and I asked her to note that the attorney had his wallet in his hand. I told the attorney that my secretary had taken down our entire conversation in shorthand. I further told him that unless he informed me that that case had been satisfactorily settled within one week, I would send him and the attorney for the plaintiff a sworn copy of the transcript.

The case was settled two days later, for $12,000, so I did not have to send a transcript to either attorney. Neither the plaintiff, nor his attorney knew exactly why the defendant decided to settle at that time, and as the attorney who tried to bribe me and the plaintiff physician are both dead, I feel at liberty to relate the foregoing incident.

That was the only instance in my rather long and varied experience in which an out-and-out bribe has been offered, although several times rather broad hints and veiled

innuendoes along similar lines have been made.

YES, I AM STILL OUT OF JAIL

A lawyer friend, who answers to the very unromantic name of Smith, always accosts me by asking if I am still out of jail. In explanation I will relate an incident wherein I came near getting into "a peck of trouble."

During a meeting of the Radiological Society in Chicago, quite a few years ago, a lawyer friend informed me that an employee of a manufacturer of apparatus was testifying against a physician friend of mine, in a medical malpractice suit.

Realizing that this might not only be injurious to my physician friend, but also to the manufacturer of apparatus, I hurriedly telephoned to the head of the manufacturing firm, telling him what his salesman was doing.

Recognizing the seriousness of the situation, he immediately sent a man post-haste to the court house to see the man who was testifying. Upon meeting, these two men engaged in considerable argument and were overheard by an attorney for the plaintiff, who immediately caused them to be brought before the judge.

Fearing to incriminate his employer, the man who had been sent down to the court, in answer to a question as to who had sent him down to stop the other man from testifying, said that I had done this, with the result that I was summoned to appear in court the next morning and explain why I should not be punished for obstructing justice, or some such equally formidable sounding charge.

I had my "day in court,"—in the judge's chambers—the next morning. The attorneys for the apparatus manufacturers managed to explain that the man who had stated that I had sent him down to the court was mistaken, and I was excused. While I had informed the firm head what was going on, I certainly had had nothing to do with the man being sent to stop the other man from testifying; but the particulars could not very well have been brought out at that time.

The joke—as it now appears, after the lapse of several years—is a good one, and I enjoy it more and more as years pass; but it was a good lesson to me, that I should be a little more careful that my name is not mentioned when I try another such stunt.

I do not hesitate to say that I would try the same thing again should a similar occasion arise, but I would first insist that my name be kept out of it.

Yes, *I am still out of jail, and hope to stay out.*

(*To be continued*)

EDITORIAL

LEON J. MENVILLE, M.D., *Editor* HOWARD P. DOUB, M.D., *Associate Editor*

PRE-OPERATIVE RADIATION OF CANCER OF THE BREAST

Statistical studies show that the present use of roentgen and radium therapy in the treatment of cancer of the breast has resulted in an increase of the so-called five-year clinical cures. It has, when used alone or in conjunction with surgery, been helpful in saving the lives of patients suffering with carcinoma of the breast, who, perhaps, would otherwise have died. The mortality rate in cancer of the breast is still much too high, and there can be but little doubt that it can be materially reduced through a better understanding by the medical profession of the mode of application and effect of radiation therapy.

Of late much has been written on the importance of pre-operative radiation in cancer of the breast, and yet there are many surgeons who will operate on breast carcinoma without pre-operative radiation. Is it because they have experienced that such treatment offers no help in these cases, or is it that they are not acquainted with what the better informed surgeons are doing in the larger medical centers? On the other hand, radiologists of experience have noted the good effect of pre-operative radiation and have shown an increase in the five-year clinical cures by its use. Pfahler (1) has shown that when pre-operative radiation was given to a group of patients suffering with cancer of the breast, 62 per cent were living after three years, and 50 per cent were living after five years. Quick (2) believes that pre-operative radiation is probably of greater relative value than post-operative radiation. Soiland (3) has forcefully expressed himself in regard to the beneficial effect of pre-operative radiation—in fact, he states that it is the first line of offense in the treatment of carcinoma of the breast and that this form of therapy should be used in all cases.

On the other hand, there are some very prominent physicians who have assumed a more conservative attitude toward the use of pre-operative radiation in cancer of the breast. For instance, Cutler (4), of the Tumor Clinic of Michael Reese Hospital, has recently stated that he utilizes pre-operative radiation in selected cases as follows: (*a*) in very young women in whom the clinical setting is such that it leads one to suspect the existence of a highly malignant anaplastic carcinoma, a type in which the results of surgery alone have been extremely unsatisfactory, and (*b*) in lesions of borderline operability. He further says that "the circumstances that appear to favor the use of pre-operative radiation are as follows: (*a*) the fact that surgery alone yields only 30 per cent five-year cures; (*b*) the probability that the mechanical trauma incident to the surgical procedure disseminates cancer emboli, and that this danger might be diminished by the use of pre-operative radiation; (*c*) the existence of a small but definite proportion of cancers of the breast which are radiosensitive, with the probability that these types are also highly malignant.

"The objections to the use of pre-operative radiation can be summarized as follows: (*a*) the possible dangers of dissemination during the waiting period between the first radiation and the surgical removal of the breast; (*b*) the increase in difficulty of the surgical procedure and interference with post-operative healing if adequate radiation is used; (*c*) the relative radioresistance of mammary cancer to doses of radiation which will still permit the safe execution of the surgical procedure."

Apparently there are different opinions in regard to pre-operative radiation and its interference with surgical procedure. May (6) mentions that pre-operative radiation does not make subsequent operative procedure more difficult or dangerous and states that Jüngling in a series of such cases has shown this to be true.

The late Dr. Joseph Colt Bloodgood (5) was a strong exponent of pre-operative radiation for cancer of the breast. Dr. Bloodgood was perhaps the most experienced breast cancer surgeon in this or any other country. Shortly before his death Dr. Bloodgood sent to the Editor of RADIOLOGY a copy of a paper he had written in which he reported three interesting cases of breast carcinoma on whom he had used radiation therapy. One of these had received pre-operative radiation therapy three months before a complete operation for cancer

was performed. Culture of the tissue taken at operation showed a definite growth of living cells, but the glands microscopically showed no involvement. The other cases had received adequate pre-operative radiation with a negative culture growth. Dr. Bloodgood stated in his article that "apparently we have sufficient evidence to demonstrate that the moment irradiation starts on a breast cancer and its metastatic area, there is no further growth of cancer cells in the cancer nodule, and no growth of cancer cells in the metastatic nodules." He also stated that "when women are properly instructed to report for examination within two weeks after the appearance of a lump in the breast and when all receive pre-operative irradiation if there is any sign of malignancy, the danger of cancer of the breast will become more and more insignificant."

There is sufficient evidence at this time to justify the need and use for the continuance of pre-operative radiation in cancer of the breast. While it is reported that this form of therapy may at times render surgical procedure more difficult, the findings of Dr. Bloodgood alone would be sufficient reason for carrying onward with this type of therapy.

REFERENCES

(1) PFAHLER, G. E.: From May (6).
(2) QUICK, DOUGLAS: Radiation in Primary Operable Breast Cancer. Jour. Am. Med. Assn., Dec. 30, 1933, **101,** 2091–2096.
(3) SOILAND, ALBERT: A Radiological Concept of the Treatment of Cancer of the Breast. RADIOLOGY, November, 1933, **21,** 498–500.
(4) CUTLER, MAX: Cancer of the Breast. Canad. Med. Jour, April, 1935, **32,** 383–389.
(5) BLOODGOOD, JOSEPH COLT: Personal communication.
(6) MAY, ERNST A.: Methods of Roentgen Treatment in Carcinoma of the Breast. RADIOLOGY, November, 1933, **21,** 420–431.

ANNOUNCEMENTS

ILLINOIS RADIOLOGICAL SOCIETY

A meeting of the Illinois Radiological Society was held at St. John's Hospital, in Springfield, Illinois, on Jan. 26, 1936. The session was opened by a two-minute silent tribute to the memory of the late Dr. W. G. Bain, Roentgenologist of St. John's Hospital, Springfield.

A most interesting program had been prepared by the local committee. Dr. R. K. Campbell presented a paper on the Indications of Collapse Therapy. This paper was discussed by Dr. Don Deal. A clinical demonstration of lipiodol injection was given by Dr. E. K. Pearson, who also presented a number of interesting films depicting the various stages and types of bronchial pathology. At the afternoon session, a paper on Pyelography was presented by Dr. Herbert Henkel and a paper on Sinus Peribronchial Lympho Adenitis was given by Dr. H. H. Cole.

Upon the recommendation of the Nominating Committee, the following officers were elected for the year 1936: R. K. Campbell, M.D., *President;* Ivan Brouse, M.D., *Vice-president;* Cesare Gianturco, M.D., *Secretary-Treasurer.*

SIXTH INTERNATIONAL CONGRESS OF PHYSICAL MEDICINE

The Sixth International Congress on Physical Medicine will be held at London, May 12–16, 1936. It will consist of sections on kinesitherapy, physical education, hydrotherapy and climatotherapy, electrotherapy, actinotherapy, roentgen therapy, and radium therapy. American participants will sail from New York on May 2, on the M.V. *Britannic,* and return on May 31, on the S.S. *Transylvania.* Dr. Richard Kovacs, 1100 Park Ave., New York, is Executive of the American Committee.

NEBRASKA STATE RADIOLOGICAL SOCIETY

The third Wednesday evening of each month has been designated as the regular meeting date of the newly organized Nebraska State Radiological Society.

BOOK REVIEWS

LA RADIOTHERAPIE DES SYNDROMES ORGANO-VEGETATIFS (SYMPATHICOTONIES, VAGONTONIES, AMPHOTONIES). By L. DELHERM, Medecin Electro-radiologiste des Hôpitaux de Paris, Chef du Service central de l'Hôpital de la Pitie; and HENRI BEAU, Medecin Electro-radiologiste des Hôpitaux de Paris, Chef-adjoint du Service central de l'Hospice de la Salpetriere. Preface du Docteur Laignel-Lavastine, Professeur a la Faculte de Medecine de Paris. A volume of 158 pages and 6 figures. Published by Masson et Cie, Paris, France, 1935. Price: 22 fr.

Many of the effects of radiotherapy in acute and chronic inflammatory conditions, as well as the relief from pain often observed in these and

other nonmalignant conditions, can be explained without reference to the sympathetic nervous system. Many radiologists feel that such effects can best be accounted for as secondary results of a direct effect on cells infiltrating inflammatory lesions, on blood cells in the circulation, and on reticulo-endothelial cells. By some radiologists, however, many of these effects have been related to a direct influence of the rays on the various parts of the sympathetic nervous system.

The present volume is an attempt to summarize the possible relationship between the effects mentioned and the sympathetic nervous system. The book is divided into three parts, the first part dealing with anatomic and physiologic considerations, with physical and technical considerations, and the fundamental notions on which the technic is based. The second part deals with the application of radiotherapy to certain disturbances of the skin, cardiac conditions such as angina pectoris, vascular disturbances such as endarteritis obliterans and hypertension, disturbances of the nervous system, of the endocrine glands such as hyperthyroidism, metabolic and osteopathic disturbances, respiratory disorders such as asthma, gastric affections such as ulcer, hyperchlorhydria, etc., and inflammatory conditions such as ozena and nephritis. The third part is given over to the expression of certain rules affecting dosage and other factors of treatment. A bibliography of twenty-two pages is included.

While no one can say absolutely that the sympathetic system is not primarily concerned in the action of roentgen rays and radium on tissues and organs, it nevertheless appears to the reviewer that this book interesting as it is, if only because it is a complete statement of the doctrine of radiation effect through the sympathetics attempts to make the sympathetic nervous system appear much more important than it is. Nevertheless, those radiologists who wish to familiarize themselves with this school of thought will find this little book of distinct interest.

X-RAY STUDIES IN ADVANCED RADIOGRAPHIC TECHNIC. Edition III. Selected Articles by Members of the Technical Service Department, X-ray Section, General Electric X-Ray Corporation, Glenn W. Files, Director. A volume of 166 pages. Published by General Electric Corporation, Chicago, 1935.

The third edition of these articles on roentgen technic is somewhat larger than the previous one published in 1931. The most notable additions are articles on "Maximum Tissue Differentiation" and "The Two Prime Essentials in the Production of the Radiograph" by Glenn W. Files. These present a well-balanced statement of the physical factors involved in the production of a roentgenogram with good advice as to proper utilization of available equipment. The statement that "the average quality of radiography has not improved to the extent made possible with the increased efficiency of x-ray apparatus" is undoubtedly true and the author presents his analysis of some of the reasons for this discrepancy. One of the most potent reasons is not given. The unfortunate situation to-day too frequently is that good apparatus in the hands of pseudo-roentgenologists fails to produce all that it is capable of because of the ignorance of the user; good apparatus in the hands of a well-trained user is so frequently overworked, with so much speed required in the production of the roentgenogram, that no time is left for the careful precision and thought which is vitally necessary in order to obtain the best technical results.

It is heartening to see so clearly developed throughout this manual the importance of individualizing technic, the complex character of the problems involved and the dignified place which radiographic technic should hold in the general development of roentgen diagnosis.

This manual, while pursuing only certain specified subjects such as the technic of roentgen examination of the spine, the chest, the stomach and colon, the sinuses and the soft tissues, is distinctly valuable. Articles on fluoroscopy of the gastro-intestinal tract by Dr. Walter C. Barker and on pelvimetry and fetal cephalometry by Dr. Robert P. Ball are also included. The section on "Anatomy from the Standpoint of X-ray Technic" makes available a good condensation of this subject for the average technician. In general, the book presents material of interest to the roentgenologist and sound instruction for the trained technician.

THE METHOD OF ACTION ON RADIUM AND X-RAYS ON LIVING TISSUES. By HECTOR A. COLWELL, M.B., PH.D., M.R.C.P., D.P.H., The Barnato Joel Laboratories, Middlesex Hospital. Awarded the Garton Prize and Gold Medal of the British Empire Cancer

Campaign 1934. A volume of 164 pages and 34 illustrations. Published by the Oxford University Press, 114 Fifth Avenue, New York, 1935. Price: $5.00.

Some twenty years ago, Colwell and Russ published the first book concerning the action of radium and roentgen rays on living cells. That book was valuable because it was the first attempt to summarize and analyze the evidence furnished by previous experimentation. In this new book Colwell considers the action of radium and roentgen rays on living tissues in the light of a great deal of additional evidence which has become available since the previous book was published. The work is divided into six chapters, of which the first is a description of the cell and of its elements as these are now known. The second chapter is devoted to a discussion of the chemical actions of the radiations as they affect colloids, oxidation and reduction phenomena, enzymes, autolysis, lecithins and cholesterol, glutathione, oxidation and carbohydrate metabolism of tissues, and the chemical composition of proteins. In the third chapter are taken up the effects of radiation on the cell membrane, the cytoplasm and cytoplasmic inclusions, the nucleus and collagen fibers. In the fourth chapter are considered the relationship of radiation with the reticulo-endothelial system, and the effects of radiation on antibody formation. In the fifth chapter is discussed the problem of radiation and resistance to tumor growth, while the final chapter is devoted to the action of radiation on malignant growths. An extensive bibliography is appended. The make-up of the book is up to the usual standard of the Oxford Medical Publications.

Those who are interested in the mode of action of radiation on cells and tissues will find this book stimulating. It is especially valuable because of the attempt to analyze many factors, the significance of which is still somewhat obscure. In spite of numerous experiments, many phases of the action of radium or roentgen rays appear decidedly puzzling. In part at least, that is probably because of the varied condition under which many investigations have been carried out. Colwell deserves much credit for having undertaken to present and to analyze evidence some of which appears contradictory but which, nevertheless, will be invaluable to investigators generally, if only because it will help to direct attention to many problems or phases of problems in which so much work remains to be done.

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APPARATUS

Investigations of the Mechanism of the Small Ionization Chamber. E. Miehlnickel. Strahlentherapie, 1935, **54,** 348.

This is a summarized presentation of the author's investigations of the small ionization chamber; the detailed report has been published in Ann. d. Phys., 1934, **20,** 737. The independence of the wave length of the small ionization chamber depends on the effective atomic number of its wall material. The air equivalence of this material depends on the effective atomic number and its independence of the wave length as compared with air. The geometric conditions governing the length of free path of the electrons also influence the independence of the wave length of a closed ionization chamber.

ERNST A. POHLE, M.D., Ph.D.

APPENDICITIS

Correlation of the Radiological and Operative Findings in Chronic Appendicitis. W. L. Harnett and G. Galstaun. British Med. Jour., Aug. 24, 1935, No. 3894, pp. 327–332.

The authors divided the 58 cases of chronic appendicitis in their series into four clinical types, as follows: Type A, cases with definite acute attacks; Type AB, cases in which acute attacks were followed by chronic symptoms; Type B, cases of appendicular colic with no history of an acute attack, and Type C, cases with vague digestive troubles but no acute attack and no appendicular colic.

The preparation of the patient for the radiologic examination is considered of the greatest importance. A mild purgative is taken by the patient from 30 to 36 hours before the opaque meal. Following this a light, residue-free diet is taken. From 8 to 12 hours before the barium sulphate is to be taken, a hot saline enema is administered to the patient.

The barium sulphate meal is taken five hours before the first x-ray examination. During this period the patient is not allowed to eat. The first examination consists of a search for residue in the stomach, in an ulcer niche, and a study of the small intestine and cecum. Following this examination, the motor meal, which should be bulky in nature and include rice or similar material, should be taken by the patient.

The second examination takes place nine hours after the original opaque meal. The small intestine at this time should be clear of barium in the normal case, and the presence of opaque material in the small bowel at this time constitutes a positive "gastro-ileal reflex." At this examination the colon and appendix should be carefully studied.

The third examination occurs at from 15 to 16 hours after the opaque meal. The head of the meal should be in the sigmoid colon and the cecum should be emptying. The fourth examination is done at 30 hours at which time the cecum and appendix should be empty. If a residue is noted at this time, further examinations are done at 42 and 50 hours.

Direct radiologic evidence of a diseased appendix consists of the following: (1) An irregularly filled appendix, with possibly, a bulbous end; (2) direct tenderness of the visualized appendix; (3) kinking of the appendix or obvious adhesions to this organ; (4) retention of the meal in the appendix for 36 hours or longer.

The indirect signs are as follows: (1) Fixation of the cecum; (2) spasm of the cecum; (3) positive gastro-ileal reflex; (4) tenderness over the cecum when the appendix is not visualized; (5) prolonged cecal stasis; (6) failure of the appendix to visualize.

While the gastro-ileal reflex occurs in other inflammatory conditions of the colon, it was present in 85 per cent of the cases of this series. Of the 31 Type A cases, indirect signs were present in 24 cases. This incidence of indirect signs was higher than in the Types AB and B cases taken together. Indirect signs were present in seven of 13 Type B cases. In the eight Type C cases, radiologic evidence of an abnormal appendix was found in every instance and confirmed at operation.

J. N. ANÉ, M.D.

BIOLOGIC EFFECTS OF RADIATION

The Biologic Effect of Roentgen Rays on Tissue Cultures. A. Faragó. Strahlentherapie, 1935, **54,** 626.

Cultures of the heart of an 8-day-old chick embryo were subjected to irradiation: 100 to 2,500 r were given at 100 kv., 1.0 mm. Al, and at 180 kv., 0.8 mm. Cu + 1.0 mm. Al, both with 40 r/min. The rate of application (intensity) was also varied in the case of the high voltage irradiation from 4 to 40 r/min. As numerical measure of the injury to the cultures, the number of fat drops in the cells were counted.

The two radiations of different wave length produced identical biologic effects. Up to 700 r, the biologic effect was proportional to the dose. Above 700 r, the effect approaches a certain limit and further increase of the dose will not increase the biologic effect. A change in the intensity, however, leads to a change in the biologic effect: it appears that the higher intensity has a more pronounced effect. It was found that neither the law of Bunsen-Roscoe nor Schwarzschild's rule applied.

ERNST A. POHLE, M.D., Ph.D.

Studies of the Fine Structure of Biologic Objects. J. v. Herman. Strahlentherapie, 1935, **54,** 645.

The author reports the results of his studies of x-ray patterns of tissue. Illustrations of patterns of tendons, heart muscle, aorta, bone, bladder stone, and fibrin are shown in the paper. The possibilities for future research along these lines are briefly discussed

ERNST A. POHLE, M.D., Ph.D.

BONE DISEASES (THERAPY)

Chronic Osteomyelitis Associated with Malignancy. Melvin S. Henderson and Howard A. Swart. Jour. Bone and Joint Surg., January, 1936, **18,** 56–60.

In a series of 2,396 cases of chronic osteomyelitis observed at the Mayo Clinic up to July 1, 1934, only five, or 0.208 per cent, were associated with malignant changes. In 1931, Benedict reported 12 cases of associated osteomyelitis and carcinoma in a total of 2,400 cases of osteomyelitis.

The Mayo group of five cases of associated osteomyelitis and malignancy consisted of four men and one woman, the ages varying from 45 to 61 years. Draining sinuses of chronic osteomyelitis had been present for an average period of 37 years in the group. The symptoms manifested by the patients with the onset of malignancy were swelling, increase in pain, hemorrhages, more profuse discharge, and the appearance of an abnormal growth. The lower third of the tibia was involved in four cases and the femur in one case. Enlarged inguinal lymph nodes were present in three cases. No other evidence of metastases was noted. The pathologic findings in this series of cases were as follows: epithelioma, Grade 1, in two cases; epithelioma, Grade 2, in two cases, and in the other case, fibrosarcoma, Grade 3, associated with squamous-cell epithelioma, Grade 3.

The treatment of these cases of associated osteomyelitis and malignancy was as follows: amputation at the junction of the middle and upper thirds of the leg in three cases; a Gritti-Stokes operation was done in one case; local excision followed by cauterization and deep roentgen therapy and radium was employed in one case in which the neoplastic process was near the hip joint. Roentgen-ray and radium treatments were used postoperatively in two cases and roentgen-ray treatment in one case.

The results of treatment in these cases were determined by the authors. Two patients who had amputations in 1925 and 1929, respectively, were well with good functioning stumps in June, 1934. One patient who had an amputation in 1924 died of chronic nephritis in March, 1935, with no evidence of extension of the malignancy. The patient who was treated by local excision in 1921 died at a later date, but the cause of death was undetermined. The patient who had an amputation for mixed fibrosarcoma and epithelioma in 1933 was living and well at the time of the report.

J. N. Ané, M.D.

BONE GROWTH

The Effect of Large Doses of X-rays on the Growth of Young Bone. Eugene M. Regen and Walter E. Wilkins. Jour. Bone and Joint Surg., January, 1936, **18,** 61–68.

Previous to this study the authors had determined that the growth of young bone was retarded by exposures to x-ray. This inhibition of growth was accompanied by a marked diminution of the phosphatase activity of the bone.

In the present study one foreleg of each of a group of pedigreed, New Zealand white rabbits was treated with x-rays, and the growth of the forelegs of the animals and those of a group of controls was studied until adult life was reached. The entire group consisted of four small litters. Each litter was represented in the experimental group of eight animals, and in the control group of six animals. The left foreleg, including the lower humerus and the entire foot, of each animal of the experimental group was irradiated. The following factors were employed: Dosage, 2,600 roentgens; kv.p. 200; ma. 20; T.S.D., 60 cm.; filtration, 0.5 mm. Cu plus 1.0 mm. Al; time of exposure, 80 minutes. Roentgenograms were made of the forelegs of all of the animals immediately after the treatment. Similar roentgenograms were also made at intervals of one month until three consecutive films showed that growth had ceased in the control bones. Special care was taken to make all exposures uniform in order that accurate measurements could be made. The bones were measured uniformly by making pinholes in the films at the ends of each bone image and measurements were thus made by means of dividers and a millimeter scale.

During the first thirty-four days following the irradiation the treated bones increased very slightly in length. During the next interval a much slighter increase in length was noted by measurements of the ulnæ. Following this, no growth was observed in any of the treated bones. Further, it was observed that no reappearance of growth occurred at any time. The untreated bones of the experimental animals grew to lengths equal to those of similar bones of the control group, thus proving that there was no generalized effect on the untreated bones of the experimental animals. At the conclusion of the experiment several of the treated animals were sacrificed and sections were made of the tissues of the treated forelegs. Examination of these sections showed that the muscles and bones were normal.

J. N. Ané, M.D.

The Influence of Roentgen Irradiation on the Rate of Healing of Fractures and the Phosphatase Activity of the Callus of Adult Bone. Eugene M. Regen and Walter E. Wilkins. Jour. Bone and Joint Surg., January, 1936, **18,** 69–79.

The authors have reported a definite inhibition of the growth of bone as the result of the application of large doses of x-rays. Brooks and Hillstrom suggested that the mechanisms of growth and repair of bone may be quite different, and some authors have suggested a stimulating effect on the healing of fractures as a result of mild x-ray therapy. McKeown and Ostergren, Kamada, and the authors have found an increase in phosphatase activity following fracture. In this study

the authors determined the effect of x-ray irradiation on the healing of fractures in adult bone by following the appearance of the fractures in roentgenograms made at regular intervals, and studied the phosphatase activity of these bones at the site of fracture throughout the period of healing.

In a preliminary study the authors treated the left foreleg of ten adult rabbits of the same stock with 1,100 roentgens and sacrificed the animals at intervals up to sixty days. Phosphatase studies made on the radii and ulnæ showed that the phosphatase activity dropped off gradually, to reach a minimum three weeks after irradiation and then increased again within sixty days.

In order to produce the fractures in the experimental animals at a time when the phosphatase activity was at a minimum, light adult female rabbits were treated over the left foreleg with 1,112 and 622 roentgens two weeks and one day, respectively, before fractures were produced. On the day after the second x-ray treatment comminuted fractures were produced in the irradiated and unirradiated ulnæ of the experimental animals and in both ulnæ of four control animals. Roentgenograms were then made of both forelegs of all twelve animals once each week. The experimental animals were sacrificed at intervals of from one to three weeks and the controls at intervals of from two to six weeks in order that determination of phosphatase activity might be obtained.

The roentgenograms revealed a marked delay in the healing of the fractures in the irradiated ulnæ as compared to the control bones. It was also noted that while the x-rays reduced the phosphatase activity of bone, complete inhibition did not result. The fracture served to increase the phosphatase activity while x-ray irradiation inhibited this increase to some extent.

J. N. Ané, M.D.

THE BREAST

Roentgen Diagnosis of Tumors of the Breast. Max Ritvo, P. F. Butler, and E. Everett O'Neil. Jour. Am. Med. Assn., Aug. 3, 1935, **105,** 343–347.

Roentgen examination affords a reliable and comparatively easy method of studying the structure, physiology, and pathology of the human breast. Neoplasms and other pathologic processes in the mammary glands can be visualized on the roentgenogram; also the changes incidental to menstruation, pregnancy, and the menopause.

After reviewing the historical phase and the anatomy of the adult female breast, the authors state that the x-ray studies require no previous preparation of the patient and cause no pain or discomfort. The technical aspects of the subject are described in detail and the roentgenographic image of the normal breast is described, with the changes associated with menstruation, pregnancy, involution and so on.

Among the pathologic conditions of the breast demonstrable by this method are: mazoplasia (chronic mastitis); cystoplasia (cystic mastitis); benign tumors (fibro-adenomas, adenomas, and fibromas); breast abscess; hematoma and fibrosis, and carcinoma of the breast. The roentgenographic characteristics of each are described. Early stages of malignancy or beginning malignant degeneration in formerly benign tumors are not demonstrable on the roentgenogram. Tumor masses can be outlined and the character and extent of the lesion determined. The existence of a neoplasm may be shown by roentgenographic examination before it can be definitely diagnosed by clinical means. Glands in the axilla and extension of malignant growths to the ribs are demonstrable on the roentgenogram.

Charles G. Sutherland, M.B. (Tor.)

Roentgen Therapy of Acute Mastitis. E. v. Gajzágó. Strahlentherapie, 1935, **54,** 639.

During the last five years the author has treated 129 cases of acute mastitis with roentgen rays; 100 of these patients are available for statistical evaluation. Technic: 190 kv., 0.5 mm. Zn + 0.5 mm. Al, 30 cm. F.S.D., 8 × 10 − 15 × 15 sq. cm., 50 − 150 r. If the patient was irradiated on the first day of illness, the results were excellent; they are not so good if treatment is delayed until the second or third day after the onset of symptoms. In the author's cases it was possible to cure 91 out of 100 patients by means of roentgen therapy; in nine cases only was it necessary to resort to surgery.

Ernst A. Pohle, M.D., Ph.D.

BURNS AND INJURIES

Roentgen Injuries. G. Nánásy. Strahlentherapie, 1935, **54,** 670.

This article gives a very brief review of the injuries produced by roentgen rays in the skin and the inner organs. The conclusions are that to-day any injury to a patient undergoing roentgen treatment is due to an error on the part of the radiologist; professional workers are injured only because of their own carelessness.

Ernst A. Pohle, M.D., Ph.D.

CANCER (DIAGNOSIS)

Observations in 26 Cases of Epithelioma on the Extremities. P. Desaive. Strahlentherapie, 1935, **54,** 227.

During the period from January, 1925, to January, 1935, a total of 4,100 carcinomas was seen at the Cancer Institute of the Surgical Clinic of Lüttich. In 26 of these cases the carcinoma was located in the extremities. The average age was 57 years, the youngest being 6 years. There were 14 males and 12 females. The pathology, regional, and other metastases are briefly discussed. The treatment consisted in radium, x-ray or surgery alone, or surgery plus radiation. One patient could not be traced, in one there was a recurrence, 13 died (7 from other diseases), and 11 are now alive and well. An appended table gives condensed but complete data on all patients.

Ernst A. Pohle, M.D., Ph.D.

CANCER (THERAPY)

The Treatment of Carcinoma of the Mouth and Hypopharynx. J. Maisin and H. Vassiliadis. Strahlentherapie, 1935, **54,** 193.

In this report from the Cancer Institute in Loewen the authors first discuss the histological and clinical classification as well as the etiology of intra-oral carcinoma and carcinoma of the hypopharynx. They emphasize that the accompanying anemia in this disease should not be treated by liver extract, but that iron and "esteromon," a preparation from dried stomach mucosa, are indicated. Barium and calcium are also given *per os;* this seems to affect the tumor growth directly, as shown in animal experiments.

Roentgen therapy has been given according to several methods. First the authors applied a total of 4,500 r (200 kv., 1.0 mm. Cu + 1.0 mm. Al, 40 cm. F.S.D.) distributed over three fields (two lateral and one posterior) during a period of from 10 to 16 days. Later on, the rate of application was decreased by increasing the focal skin distance to 60 cm. and filter to 2.0 mm. Cu. Since 1932 the Coutard method has been used, increasing the treatment period to 21 days. The daily dose per field is 250 r; the two lateral fields receive 2,000 r each, and the posterior area from 1,000 to 1,500 r.

Radium is applied in three forms. A small number of cases have been treated with telecurietherapy using a radium bomb with 1.4 gram of radium filtered through 1.0 mm. Pt at 6 cm. distance. One-hour exposure daily for 20 days produces a definite skin reaction. A second method is the preparation of radium molds using about 200 mg. of radium filtered through 1.0 mm. Pt at 3 cm. distance. In addition to that, radium needles filtered through 0.5 mm. Pt and containing 1 mg. of radium per cm. of length can be introduced into the tumor. It is important to remove first every diseased tooth as well as all healthy teeth in the immediate vicinity of the growth. It is sometimes impossible to avoid a necrosis of the mandible. The needles remain in place from 4 to 7 days. In tumors of the floor of the mouth it is sometimes easier to introduce the needles through the outer skin. Because of the difficulties in swallowing as soon as the reaction develops, it is sometimes necessary to feed these patients through a sound introduced into the nose. Metastatic glands, if operable, are usually removed. As soon as the wound has closed, approximately from 10 to 12 days post-operative, radiation therapy is started, either x-ray or radium. More recently the authors have given x-ray or radium therapy a trial before resorting to surgery. If the glands disappear, no surgery is contemplated; otherwise, operative removal two months following the last treatment. It is emphasized that even apparently uninvolved glands should be given prophylactic radiation therapy.

In five tables the cases treated by the authors are statistically analyzed. When comparing the patients receiving radiation therapy alone and radiation therapy plus barium medication, it was interesting to note that out of 154 cases irradiated only 36 (or 23.3 per cent) survived at the end of three years. In 26 cases that had radiation plus barium this percentage was increased to 50 per cent.

In conclusion, it is stated that with radiation therapy in carcinoma of the mouth and hypopharynx, survival periods of from five to eight years may be obtained. The statistics presented in the paper seem to indicate that barium medication is an effective supplement to radiation therapy.

ERNST A. POHLE, M.D., Ph.D.

Radiation Therapy of Post-operative Recurrence of Uterine Carcinoma. I. von Büben. Strahlentherapie, 1935, **54,** 607.

During the period from 1920 to 1930, 108 cases of uterine carcinoma (103 of the cervix and 5 of the fundus), with recurrences following operation, were treated at the author's clinic. Of these, 90 had received irradiation for prophylactic purposes; 62 had a combination of roentgen rays and radium, 28 had roentgen therapy only. In 96 instances of local recurrence, 52 patients were free from symptoms for one year, three for four years, and seven for five years and longer. Eight patients had metastases in the lymph glands; two remained free from symptoms for one year after irradiation. Sixty-nine patients could be observed over a period of five years: 10 per cent remained well for the five-year period.

The local recurrences in the cervical stump were treated with 25 mg. of radium filtered through 1.5 mm. Pt and received a dose of from 3,000 to 3,600 milligram-hours. Roentgen therapy consisted of 20 sittings of 100 r (in air), each with 190 kv., 0.5 mm. Zn + 0.5 mm. Al, 60 cm. F.S.D., 7 r/min. The author concludes that in the treatment of post-operative recurrence of uterine cancer radiation therapy is the method of choice.

ERNST A. POHLE, M.D. Ph.D.

The Effect of Radium and Roentgen Rays on the Magnesium Content of the Serum and the Carcinoma Tissue in Cancer of the Uterus. H. Winkler. Strahlentherapie, 1935, **54,** 294.

The author studied the magnesium content in the serum of 20 normal persons, 11 patients with fundal carcinoma, 24 patients with carcinoma of the cervix of first and second stages, and 21 patients of third and fourth stages. The serum in patients following irradiation and the carcinomatous tissue in a few were examined for magnesium content after irradiation. It was found that in early carcinoma the magnesium content of the blood serum is definitely increased. Under radium and roentgen treatment the magnesium content returns to normal following an initial increase (early cases). In advanced carcinoma the magnesium content of the serum first increases after irradiation but does not drop to the normal value and remains high. In the tumor tissue itself there also occurs an increase in magnesium under combined roentgen and radium treatment followed by a drop to the initial value.

ERNST A. POHLE, M.D., Ph.D.

CONTRAST MEDIA

The Late Effects of the Intravenous Injection of Colloidal Thorium Dioxide. Domenico Vajano. Archivio di Radiologia, March-April, 1935, **11**, 127–142.

The author here reports a radiologic and histologic check-up made three years after administration of thorotrast. He feels that up to date and with the usual dosage hepatolienography is not a dangerous procedure. However, because of the possibility of the late effect from the radio-activity of the substance, he does not feel justified in stating that the method is devoid of all risk. He presents typical roentgenograms of his animals, supplements them with photomicrographs, and then summarizes his observations in a tabulation.

E. T. LEDDY, M.D.

DERMATOLOGY

The Fate of Patients with Skin Disease Treated with Roentgen Rays from 1926 to 1931. N. v. Thoroczkay. Strahlentherapie, 1935, **54**, 690.

In the University skin clinic in Budapest a total of 5,438 patients with skin disease were treated by roentgen rays during the period from 1926 to 1931. The author conducted a follow-up study and succeeded in reaching 464 cases. Of 101 patients with eczema, 34.4 per cent were cured; 11.8 per cent remained free from symptoms for several years; 15.84 per cent received no benefit from the treatment. Of 27 cases treated by Grenz rays, 44.5 per cent were cured, 3.7 per cent remained free from symptoms for several years, and 7.3 per cent had no benefit from the treatment. Of the 270 patients treated because of neurodermite, 30.5 per cent were cured and 56.5 per cent received no benefit from the treatment. Of 19 cases of dyshidrosis, 31.6 per cent were cured, 26.25 per cent remained free from symptoms for several years, and 21 per cent remained unchanged. Six cases of this type were treated by Grenz rays: one was cured, two remained free from symptoms for a number of years, and two did not respond. Of eight cases of acne vulgaris, only two were cured. In diseases due to the fungi involving the scalp, good results were obtained by a combination of roentgen epilation and thallium medication internally in all of 168 cases. Of the 23 patients with epithelioma, 17.2 per cent were cured, while 39.7 per cent were not benefited at all. In conclusion, the author remarks that the percentage of good results observed in his patients is not nearly as good as some results reported in the literature.

ERNST A. POHLE, M.D., Ph.D.

DOSAGE

Comparative Histological Studies of the Skin Reaction Following Fractional and Protracted Fractional Roentgen Therapy. W. Czunft and A. Gaál. Strahlentherapie, 1935, **54**, 616.

The authors studied the histological changes in human skin following exposure to filtered roentgen rays applied according to the simple fractional method and the protracted fractional method. Technic: 185 kv., 0.5 mm. Cu, 0.5 mm. Al, H.V.L. in copper 1.0 mm., 3 −4 r/min., 180 r daily, for the protracted fractional application, and 15 − 20 r/min., 200 r daily, for the simple fractional application. A total of fourteen biopsies was taken. The microscopic findings are described in detail and six photomicrograms are appended.

It is concluded that histologically there was no detectable difference between the two methods of irradiation. These findings seem to support the opinion of other investigators who believe that the fractionating is the principal factor in increasing the skin tolerance. The protraction is of secondary importance. Whether there would be any difference after years, particularly as far as late reactions are concerned, no definite statement can be made, since the authors' cases were not observed longer than 18 months.

ERNST A. POHLE. M.D., Ph.D.

Quality of Radiation and Skin Reaction. G. Schwarz and A. Frank. Strahlentherapie, 1935, **54**, 83.

In a previous publication the authors reported the results of their studies regarding the relation between wave length and skin erythema (Strahlentherapie, 1934, **50**, 145). They continued their investigations and now have compared the reactions produced by two qualities of radiation: 60 kv., 1.0 mm. Al and 170 kv., 0.5 mm. Cu + 2.0 mm. Al. The F.S.D. was 20 cm., the rate of application 27 r per minute, the total dose (over the thigh in an area of 4 × 4 cm.) 1,600 r given in one sitting. The observations made lead the authors to the conclusion that it is erroneous to consider "soft" roentgen rays more dangerous to the skin than "hard" rays. They found that the skin reaction developing in the field exposed to 170 kv. was much more severe than the one produced by 60 kv. roentgen rays, in spite of the fact that all other factors remained the same. They also state that identical doses as measured by thimble chambers between potentials of 60 to 110 kv. produced identical skin reactions.

ERNST A. POHLE, M.D., Ph.D.

Quantitative Changes in the Blood Picture Following Total Body Irradiation Applied According to Various Fractional Dose Methods and Various Doses. K. Wolff. Strahlentherapie, 1935, **54**, 68.

Rabbits were exposed to roentgen rays over the entire body; the total dose amounted to 1,045 r given in fractional doses over a period of five days. Since all animals died shortly after the last exposure the daily doses were reduced and the treatment period prolonged but the total dose increased to 2,145 r. The blood changes observed were of a temporary nature; the only permanent injury was noted in the thrombocytes. The author concludes from his observations, therefore, that fractional doses extended over a sufficiently long period are better tolerated both in the form of local and general body exposure.

ERNST A. POHLE, M.D., Ph.D.

EPILATION OF SCALP

Temporary Epilation of the Scalp. J. Végh. Strahlentherapie, 1935, **54,** 707.

The author made a thorough study of the problem of temporary epilation of the human scalp. His experiments comprise 404 cases of mycotic hair disease in children and 84 cases with affections of the beard in adults. It appeared that five fields with 350 r per area at 130 kv., 0.5 — 1.0 mm. Al at 23 cm. F.S.D. and 139 r/min. represents the most suitable technic. The additional administration of thallium internally is unnecessary if roentgen therapy is applied according to the above technic.

ERNST A. POHLE, M.D., Ph.D.

THE FOOT

Congenital Absence of the Medial Sesamoid Bone of the Great Toe: Report of Two Cases. George A. L. Inge. Jour. Bone and Joint Surg., January, 1936, **18,** 188–190.

The author reports two cases of congenital absence of the medial sesamoid bone at the metatarso-phalangeal joint of the great toe. The two patients were adults, one male and the other female. Roentgenograms revealed the absence of the left medial sesamoid in each case. Neither patient had symptoms referable to these bones, and their statements that no operation had been performed on the foot was substantiated by the absence of any surgical scar.

J. N. ANÉ, M.D.

FOREIGN BODIES

Roentgen Diagnosis of Foreign Bodies in the Esophagus. Sven R. Kjellberg. Acta Radiologica, 1935, **16,** 478–484.

The author points out the difficulty of diagnosis of foreign bodies in the esophagus by the x-ray when they are of low opacity. He states that obstruction (if the body is large), residual coating of barium around the foreign body, entrance of small air bubbles through breaks in the mucosa, local swelling of the surrounding soft tissues, and dilatation of the esophageal wall are aids to diagnosis. Case reports are given.

E. M. SHEBESTA, M.D.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

Diagnostic Gastroscopy, with Special Reference to the Flexible Gastroscope. Rudolf Schindler. Jour. Am. Med. Assn., Aug. 3, 1935, **105,** 352–355.

In 1868 Kussmaul introduced a rigid open tube into the stomach of a sword swallower. His efforts were not successful, because there was no adequate way of lighting the interior of the stomach. Mikulicz devised an instrument with an elbow or knee, which he thought would provide for the necessary angle at the cardia. The instrument combined a closed tube with a lamp at the end, and the objective of the optical system just proximal to the light. He began using this instrument in 1881, but it proved large and complicated, perhaps dangerous, and he gave up his efforts to visualize the interior of the stomach. Various attempts were made with different modifications, but gastroscopy was practically forgotten from 1911 to 1922. At this time Schindler constructed a rigid gastroscope and used it until he perfected and announced a flexible gastroscope in 1932. With his two instruments he has carried out about 2,000 examinations, approximately one-third of these being made with the flexible instrument.

The procedure in the hands of a trained specialist is rather a simple one and may be carried out in the office or clinic. After the examination, the patient may return at once to his work, and no prolonged disability results. With the flexible instrument the contraindications are practically those which exist for the passage of a stomach tube, such as aortic aneurysm, esophageal varices, and angina pectoris. There are occasionally cases in which benign gastric ulcer is demonstrated roentgenologically and in which the gastroscope fails to locate it. The converse has been experienced. Malignant gastric ulcers present a decidedly different picture from that seen in benign ulcers. A non-ulcerating carcinoma or lymphosarcoma is usually unmistakable. Jejunal ulcers may be observed occasionally with the gastroscope. Gastritis is of frequent occurrence and three forms are distinguished: superficial gastritis, which apparently involves only the superficial layers of the mucosa and does not produce any interstitial changes; artrophic gastritis, in which the mucosa has apparently atrophied, and hypertrophic gastritis, in which the mucous membrane is velvet-like and swollen and contains a number of nodules or wart-like excresences, with numerous creases between the elevations. Frequently, very small and superficial ulcers are present. The gastroscopic appearances of the different lesions are described.

CHARLES G. SUTHERLAND, M.B. (Tor.)

The Diagnosis and Prognosis of Epithelial Tumors of the Large Bowel (Chairman's Address). Walter A. Fansler. Jour. Am. Med. Assn., July 20, 1935, **105,** 167–169.

Tumors actually arising from the bowel epithelium must be differentiated masses projecting into the bowel lumen and are merely covered with bowel mucosa. When the mucosa is ulcerated or when a tumor has broken through the mucosa and is projecting into the bowel lumen, as is sometimes the case with prostatic carcinoma or metastatic nodes in the rectovesical pouch, or cul de sac of Douglas, some confusion may arise. Certain tumors arising in the bowel wall, such as lipomas or myxomas, may give this picture, as may masses arising entirely outside the bowel, as in the case of presacral dermoid cysts or meningocele. Likewise, inflammatory conditions with ulceration, such as amebic dysentery, ulcerative colitis, tuberculosis, actinomycosis, syphilis, lymphogranuloma inguinale, diverticulitis, or inflammatory conditions due to intestinal parasites, may simulate to some degree epithelial tumors. While an epithelial tumor may be malignant from its inception, many tumors remain benign, or

malignant changes only occur after a long period of time.

In advanced lesions, if they are viewed through the proctoscope the diagnosis is usually apparent; when the lesion is too high for visualization roentgen examination will almost invariably confirm the clinical subjective and objective findings.

The only other condition that should be termed "advanced" is multiple polyposis, or, more accurately, multiple adenomatosis. The growths usually extend low enough to be visualized, and the x-rays will reveal how much of the bowel is involved. Almost certain development of a malignant growth or death from intercurrent disease is the fate of these patients, if untreated.

Small epithelial tumors frequently give no symptoms. If low enough to be seen through the proctoscope, they can be readily diagnosed; but above this area diagnosis is often impossible.

All epithelial tumors except the degenerated fibrous type offer some danger from malignant degeneration. Some of these tumors, especially the flat button-like lesions, are frequently malignant from their earliest development. Because of this danger all epithelial tumors, no matter how small, within reach of the proctoscope should be destroyed by electrocoagulation or fulguration. Small tumors with a definite pedicle that cannot be reached through a proctoscope should be observed periodically and removed at once if there is any sign of activity.

CHARLES G. SUTHERLAND, M.B. (Tor.)

Contribution to the Knowledge of the Roentgen Picture of Pneumatosis Cystoides Intestinorum. Gosta Groberger. Acta Radiologica, 1935, **16,** 439–444.

The author discusses pneumatosis cystoides intestinorum formation of multiple gas-containing cysts along the alimentary canal, at times also the mesentery and its lymph nodes, omentum and peritoneum. Such cysts are possibly due to a specific infection. About 100 cases have, so far, been reported. They are more common in swine, sheep, and chickens. He considers briefly the etiology and symptoms, and reports one case. He directs attention to the possibility of diagnosis by roentgenograms of this rare disease: the clinical symptoms alone are not diagnostic.

E. M. SHEBESTA, M.D.

THE HAND

Destruction of Epiphyses by Freezing. Ruth Blount Bennett and W. P. Blount. Jour. Am. Med. Assn., Aug. 31, 1935, **105,** 661, 662.

A girl, aged 8 years, had frozen all the fingers of the left hand, in December, 1931, with subsequent loss of the finger nails. Swelling appeared in June, 1932. When first seen in July, 1932, there was swelling of the proximal interphalangeal joints of digits two, three, and four, crepitation, and some limitation of motion. The third and fourth digits were crooked, with the apex of the angle medially and at the proximal interphalangeal joint.

Roentgen studies taken in December, 1932, showed a slight generalized bone atrophy of the bone. The epiphyses of the first digit, the other four metacarpals, and the proximal phalanges were otherwise normal in appearance. The epiphysis at the proximal end of the fifth middle phalanx was also normal. Those of the distal phalanges of the second, third, fourth, and fifth digits as well as the middle phalanges of the second, third, and fourth digits were entirely absent. The metaphyses at these points were markedly irregular in contour and appeared moth-eaten. The same irregular appearance was evident on the contiguous surfaces of the neighboring phalanges where there was no epiphysis. The proximal interphalangeal joints of the third and fourth digits were angulated with the apex laterally.

The changes were similar to those seen following Volkmann's ischemia.

CHARLES G. SUTHERLAND, M.B. (Tor.)

THE HIP JOINT

Supratrochanteric Calcification. Raphael R. Goldenberg and Gottlieb S. Leventhal. Jour. Bone and Joint Surg., January, 1936, **18,** 205–211.

The authors reviewed roentgenograms of 650 hip joints and found that 100 were of patients less than 15 years of age, while 550 were of patients between the ages of 15 and 69 years. In this group of 550 cases, calcification in the region of the greater trochanter was noted in 30 cases, or 5.4 per cent. The average age of this group of patients was 45 years. In 25 cases of this group the records were sufficiently complete to warrant further study. Of these 25 patients, 64 per cent gave a history of trauma; 24 per cent presented foci of infection, and 12 per cent showed evidence of osteo-arthritis elsewhere. Abduction and internal rotation, due to reflex spasm of the gluteus medius, were noted to be limited.

The three bursæ which are present in the region of the greater trochanter are those of the gluteus maximus, gluteus medius, and gluteus minimus. Three locations of calcified deposits in the region of the greater trochanter were noted, as follows: (1) in the tendon of the gluteus medius; (2) in the bursa between the tendon of the gluteus medius and the greater trochanter; (3) on the under-surface of the gluteus medius and not connected with the trochanter. Of the 30 positive roentgenograms, 28 showed the deposits in the tendon of the gluteus medius; eight, in the bursa between the tendon of the gluteus medius and the greater trochanter, and two, on the under-surface of the gluteus medius.

The authors are of the opinion that the pathogenesis of this condition is similar to that which occurs in the supraspinatus muscle at the shoulder joint. The treatment of the syndrome consists of the surgical removal of the calcified deposits.

J. N. ANÉ, M.D.

Intrapelvic Protrusion of the Acetabulum (Otto Pelvis). Walter N. Levin. Jour. Am. Med. Assn., July 13, 1935, **105,** 112, 113.

Intrapelvic protrusion of the acetabulum is a condi-

tion characterized clinically by pain and limitation of motion in the hip. This restriction of motion is particularly noted in abduction and rotation, and often in adduction, flexion, and hyperextension. Muscular atrophy of the thighs is not uncommon, and a peculiar gait described as "waddling" or "wabbling" is present in late cases. The disease may be unilateral or bilateral.

Roentgenologically there is deepening of the acetabulum, with a medial displacement and thinning of its inner wall. The femoral head also shows changes, but these changes are less marked. The general contour of the head may be retained, but there is usually an irregularity of outline and a thinning of the articular cartilage. The joint space is narrowed. The greater trochanter is much closer to the ilium and, in advanced cases, may impinge on it.

The etiology is unknown. Philip Lewin believes that it is due to a combination of factors, which are: (1) hypertrophic arthritis of the hip joint; (2) weakening of the acetabular floor; (3) trauma due to weight-bearing or injury, and (4) muscular contraction forcing the head of the femur against the acetabular floor.

The prognosis is poor. Ankylosis ultimately occurs, with a resultant disappearance of pain.

CHARLES G. SUTHERLAND, M.B. (Tor.)

INFLAMMATORY DISEASES

Roentgen Therapy of Inflammatory Diseases in Stomatology. A. Róna. Strahlentherapie, 1935, **54,** 680.

The author recommends small to moderate doses of roentgen rays (40 – 60 r) in periodontitis, granuloma, and pyorrhea. The treatment was also given a trial in chronic recurrent osteomyelitis with fistula; the dose was increased to 150 r. Data on 27 cases are tabulated. The results were so encouraging that the author urges the use of roentgen therapy in all patients of this type.

ERNST A. POHLE, M.D., Ph.D.

THE KIDNEYS

The Management of Renal Tumors, Including Cysts. R. M. LeComte. Jour. Am. Med. Assn., Dec. 14, 1935, **105,** 1963–1965.

Malignant growths of the parenchyma of the kidney may be classified broadly as hypernephromas and carcinomas. Hypernephromas have an irregular cellular structure and are radiosensitive, while carcinomas have a fairly typical microscopic arrangement and are apt to be radioresistant. Apart from their histologic structure, sarcomas and teratomas have practically the same characteristics as hypernephromas. Neoplasms of the kidney pelvis are squamous-cell growths, similar to those occurring in the bladder, and are not sensitive to the roentgen ray and have just as indefinite an evolution as do vesical tumors.

Benign growths of the parenchyma are usually small and harmless but may become large enough to produce clinical symptoms. Any renal or pelvic neoplasm that can be recognized clinically should be considered as actually or potentially malignant, and treated as such.

Pre-operative irradiation induces fibrotic changes in cortical tumors and makes their removal less difficult; while irradiation may alter the tumor beneficially, it will not destroy it completely.

Radiotherapy should certainly be used in cases classed as either borderline or inoperable, in the hope that removal may be made easier or that otherwise hopeless cases may be brought within the possibilities of surgical relief. Post-operative irradiation to eliminate possible rests that have been overlooked or deliberately left behind is indicated.

CHARLES G. SUTHERLAND, M.B. (Tor.)

Roentgen Irradiation of the Kidneys in Cases of Mercury Bichloride Poisoning. J. Balázs and W. Czunft. Strahlentherapie, 1935, **54,** 600.

The authors used small doses of roentgen rays in several cases of mercury bichloride poisoning. Technic: 165 – 185 kv., 0.5 mm. Cu + 1.0 mm. Al, 30 cm. F.S.D., 20 r/min., 65 – 150 r effective in the kidneys. The smaller doses were applied daily up to six times, the larger doses only two or three times. Careful analysis of the urine showed that the amount excreted was increased following irradiation but no qualitative changes in its composition could be observed. While it is permissible, therefore, to give small doses of roentgen rays a trial in cases of mercury bichloride poisoning, no cure of this condition is to be expected from irradiation.

ERNST A. POHLE, M.D., Ph.D.

LEUKEMIA

Remarks Regarding the Treatment of Chronic Leukemia. H. Curschmann. Strahlentherapie, 1935, **54,** 79.

The author is not satisfied with the results obtained by radiation therapy in leukemia. A critical review of the literature shows that the results of other clinicians are not more encouraging than his own. He observed recently two cases of leukemia in which acute infection—one patient had influenza, the other erysipelas—materially improved the leukemic process. The author suggests, therefore, that the attempts made years ago be revived; for instance, by Coley with injections of serum, and that vaccine therapy in leukemia be given another trial.

ERNST A. POHLE, M.D., Ph.D.

THE LIVER

Primary Carcinoma of Liver, with Hepatosplenography. D. E. Ehrlich and F. C. Ansanelli. Jour. Am. Med. Assn., Aug. 3, 1935, **105,** 355, 356.

Primary carcinoma of the liver is a rare entity both clinically and at autopsy. The lesion is present in approximately one out of 2,000 necropsies. While primary carcinoma is usually found to involve the right lobe of the liver, the authors report a case in which it involved the left lobe. On physical examination a mass was

palpated between the epigastrium and the umbilicus, slightly movable and located more to the left of the median line. A flat roentgenogram showed a soft tissue shadow in the epigastrium. Examination of the gastro-intestinal tract revealed no intrinsic lesion, other than a narrowing of the distal portion of the transverse colon suggesting a pressure deformity of an extrinsic nature. Hepatosplenography (75 c.c. of thorium dioxide sol in seven days, with no untoward reactions) revealed marked enlargement of the left lobe of the liver upward and downward, the lower border extending to the first lumbar intervertebral disc, and slight enlargement of the right lobe. In the upper third of the left lobe were areas of lessened density. In the lower two-thirds of the same was a well-delineated semicircular mass of lessened density. An area of lessened density was seen in the right lobe.

The clinical diagnoses, in order, were: metastatic cancer of the liver; primary cancer of the liver. The pathologic diagnosis was primary carcinoma of the left lobe of the liver.

CHARLES G. SUTHERLAND, M.B. (Tor.)

MEDICO-LEGAL PROCEDURE

Medico-legal (Expert Testimony). Law and Contemporary Problems, October, 1935, **22,** 401–527. School of Law, Duke University, Duke Station, Durham, N. C. (60 cents).

Physicians and others interested in expert testimony will find much instructive information in the above-mentioned magazine. The October number contains the following papers: "The Development of the Use of Expert Testimony," by Lloyd L. Rosenthal, LL.B., of the New York bar; "An Alternative to the Battle of Experts: Hospital Examination of Criminal Defendants before Trial," by Henry Weihofen, J.S.D., of the School of Law of the University of Colorado; "The History and Operation of the Briggs Law of Massachusetts," by Winfred Overholser, M.D.; "Psychiatric Testimony in Probate Proceedings," by Harold S. Hulbert, M.D., a psychiatric expert of national repute; "The Qualifications of Psychiatrists as Experts in Legal Proceedings," by Israel Strauss, M.D., of New York; "Medical Testimony in Personal Injury Cases," by Frederick E. Elliott, M.D., and Ramsay Spillman, M.D., two well-known New York roentgenologists; "Expert Medical Testimony in Compensation Cases," by Ruth A. Yerion, LL.B.; "Reasons and Reasoning in Expert Testimony," by Albert Osborne, an expert in questioned documents; "The Admissibility of Scientific Evidence in Criminal Cases," by Fred E. Inbau, LL.B., LL.M., of Northwestern University, Scientific Crime Detection Laboratory; "The Expert Witness in Criminal Cases in France, Germany, and Italy," by Morris Plascoe, LL.B., of the New York bar, and "The Compensation of Expert Witnesses," by Horace L. Bowers, Jr., President of Duke Bar Association.

The foregoing eleven papers make up a group of subjects covering 124 pages of as highly instructive and profitable reading as one interested in the legal side of medicine will find in many days' search.

I. S. TROSTLER, M.D.

NEURALGIA

Contribution to the Analgesic Effect of Roentgen Rays. P. v. Mészöly. Strahlentherapie, 1935, **54,** 658.

The author presents an analysis of 140 cases in which x-rays were used for analgesic purposes. Eleven patients with neuralgia of the third nerve were treated; 11 of these remained free from symptoms for a period of two years or more; two were definitely improved. Technic: 170 kv., 0.5 mm. Zn, 8 × 10 sq. cm., 50 r/min., 400 − 450 r directed to the lateral aspect of the face. This dose was repeated three times at intervals of six weeks. Of the 67 cases of ischias treated, 42 were cured, 18 improved, five had less pain, and two did not respond to the treatment. Technic: 140 kv., 0.5 mm. Zn, two fields of 15 × 20 sq. cm. over the lower lumbar and sacral region on the involved side; 400 − 500 r per field, repeated twice at intervals of six weeks. Sometimes 300 r were given over the popliteal fossa.

Seventeen cases of neuralgia in various parts of the body were also treated with a technic similar to that used in treating the third nerve; they all responded well to irradiation.

Six patients who had developed pain following an operation (appendectomy and tonsillectomy) were also subjected to irradiation; the results were encouraging. Similar experience was noted in four cases with pain following extraction of teeth. A statistical evaluation of the 105 cases shows that 91 per cent were materially benefited by roentgen therapy.

ERNST A. POHLE, M.D., Ph.D.

PEPTIC ULCER

Gastric Ulcers on the Posterior Wall and the Cardiac End of the Stomach. Josef Pinke. Röntgenpraxis, October, 1935, **7,** 656–664.

According to a review of pathologic-anatomic statistics about 13 per cent of all gastric ulcers are found on the posterior wall and 5.5 per cent in the cardiac end of the stomach. The author's experience in roentgenologic examination of the stomach showed that 130 roentgenologically diagnosed gastric ulcers (7.7 per cent) were on the posterior wall and 3.8 per cent in the cardiac end.

The only direct sign for ulcers is a niche, which is often difficult to demonstrate on the posterior wall. A relief examination of the gastric wall is of greatest importance; that is, examination with a very small amount of barium. Films taken with the patient lying on his back are often better than when he is lying on the abdomen. The star-like formation of the mucosa is often a good sign for an active or healed ulcer. Local spasm of the stomach is an indirect sign, as also the hour-glass deformity. A cascade deformity was not seen in ulcers.

Niches in the cardiac end are quite often difficult to

show; the cardia must be examined in different positions. One must be careful not to mistake prominent mucosa folds as deformities due to an ulcer.

HANS W. HEFKE, M.D.

RADIUM

The Independence of the Wave Length of the Effect of Roentgen Rays and Gamma Rays of Radium on Mutations in *Drosophila melanogaster*. N. W. Timoféeff-Ressovsky and K. G. Zimmer. Strahlentherapie, 1935, **54,** 265.

Very soft roentgen rays (10 kv., H.V.L. in cellophane 0.24 mm.) produce 2.52 per cent mutations in the fruit fly following doses of 1,000 r. There is strict proportionality between the dose and the rate of mutations. A comparison of the effect of roentgen rays of 2.1 Å. and 0.35 Å. and gamma rays of radium (0.02 Å.) showed that there was no influence of the wave length on the genetic effect, provided, of course, that the doses were equivalent as expressed in r. A biophysical analysis of the results of the experiments leads the authors to the conclusion that "one hit" suffices to produce a mutation; "one hit" is defined as an ionization or excitation of an atom along the path of the secondary electron.

ERNST A. POHLE, M.D., Ph.D.

Radium Therapy of Climacteric Hemorrhage. J. Molnár. Strahlentherapie, 1935, **54,** 664.

Roentgen therapy is usually given perference in treating excessive bleeding during the climacterium. It does not require hospitalization and is free from the dangers connected with any uterine manipulation. Radium is indicated, however, if the patient has lost a considerable amount of blood and it is imperative to bring about immediate cessation of the hemorrhage. The author usually applies from 20 to 40 mg. of radium, filtered through 1.0 mm. Pt, for from 24 to 48 hours, giving an average dose of from 480 to 960 milligram-hours.

ERNST A. POHLE, M.D., Ph.D.

Radium Therapy in Uterine Fibroid and Hemorrhagic Metropathy. H. Weigand. Strahlentherapie, 1935, **54,** 577.

The author compares roentgen and radium rays in the treatment of uterine fibroid. He concludes that radium is at least equal to roentgen rays, if not superior. He considers as the chief advantages of radium therapy the exact dosage, the quicker effect on the bleeding, the milder effect on the ovaries, and the less severe climacteric symptoms.

ERNST A. POHLE, M.D., Ph.D.

The Distribution of Radiant Energy around Radium Applicators. T. C. Neeff. Strahlentherapie, 1935, **54,** 507.

It is important for the radiotherapist to know the distribution of radiant energy around a radium screen or a combination of screens. The author has used the photographic method to demonstrate the relation between secondary radiation, filter, distance, and the isodose curves. This well illustrated paper is recommended for study in the original.

ERNST A. POHLE, M.D., Ph.D.

Radium Dosage in r in Gynecological Practice. H. Kirchhoff and V. Beato. Strahlentherapie, 1935, **54,** 462.

In order to express the radium dose applied in treating uterine carcinoma in international r, the authors used the photographic method described recently by Holthusen ("Strahlentherapie," 1935, **53,** 543 and 552). Their results are given in a number of graphs (isodose curves) and tables. The Hammer dosimeter for radium is also suitable for these measurements and is, according to the authors, simple in operation.

ERNST A. POHLE, M.D., Ph.D.

Bladder Injuries Following Radium Treatment for Uterine Carcinoma. F. v. Mikulicz-Radecki. Strahlentherapie, 1935, **54,** 493.

The author reports in detail two cases that developed bladder injury following radium and roentgen applications to the pelvis. The doses applied are given and the treatment is outlined. He recommends cystoscopic examination of *all* patients who receive heavy doses of roentgen rays or radium to the pelvic structures.

ERNST A. POHLE, M.D., Ph.D.

The Present Status of Radium Dosimetry. W. Freidrich. Strahlentherapie, 1935, **54,** 397.

The author presents a brief historical sketch showing the development of dosimetry in radium therapy. He believes that recent investigations show that the r will eventually be used as unit in radium therapy.

ERNST A. POHLE, M.D., Ph.D.

SARCOMA

Concurrent Osteogenic Sarcoma in Brother and Sisters. C. W. Roberts and Charles P. Roberts. Jour. Am. Med. Assn., July 20, 1935, **105,** 181–185.

The authors present cases of spontaneous and concurrent development of bone sarcoma in three members of one family: a brother and two sisters, aged severally 23, 17, and 13.

These cases strongly support the hypothesis of a genetic origin or diathesis in the development of malignant tumors. It would appear that a spontaneous susceptibility to autonymous cell growth was resident in the osseous system of these individuals and perhaps localized to it.

Three different major long bones (humerus, tibia, and femur) were the sites of origin of the tumors. The appearance of all three sarcomas in a right extremity is perhaps fortuitous, rather than dependent on dextrolateral segregation of the "malignant factor" during oval division.

Injury was never the primary exciting cause, but its rôle was definitely one of aggravation and acceleration of already existent sarcoma. Cultures and smears of

the bone marrow at the time of amputation in Case 3 revealed no organisms.

That there may be some dietary deficiency factor bearing a primary or aggravating rôle in the development of sarcoma is suggested by the environment in which this family lived. It is plausible to assume that their economic status failed to provide a balanced fare.

CHARLES G. SUTHERLAND, M.B. (Tor.)

Radiation Therapy of Osteogenic Sarcoma and the Reaction of the Bone to Roentgen Irradiation. B. Dahl. Strahlentherapie, 1935, **54,** 35.

The author describes six cases of osteogenic sarcoma which were, contrary to the general belief, rather radiosensitive. Roentgenograms of some of the involved bones, photographs of gross specimens removed at operation, and photomicrograms of the neoplasms are appended. One case developed bone necrosis following irradiation and the course of the reaction is described in detail. When treating sarcoma of the femur the author usually applied three fields with the central rays at an angle of 120 degrees, fields of approximately 20 sq. cm. and total doses over each area of from 1,950 to 2,250 (Coutard technic, heavy filtration, long distance, 4 r per minute; 100–250 r per day). For sarcoma of the forearm and occasionally for sarcoma in the lower part of the femur, only two fields were applied giving 2,850–3,050 r over each area. The author discusses the relationship between the skin tolerance dose, the bone tolerance dose, and the dose, necessary to bring about destruction of the tumor tissue.

ERNST A. POHLE, M.D., Ph.D.

SILICOSIS

Some Roentgenologic Observations Regarding Pulmonary Silicosis in Porcelain Workers. Gunnar Jonsson. Acta Radiologica, 1935, **16,** 431–438.

This paper reports results of roentgenologic observations on 236 porcelain workers in Sweden. The pathologic and anatomic changes due to silicosis are discussed, along with their correlation to radiographic changes found in the three stages of the disease, which are characterized as follows:

Stage I. Small shadows the size of a pinhead or less.

Stage II. Larger shadows up to the size of a lentil or a very small pea.

Stage III. Large massive shadows with contraction.

The author concludes that hilum changes alone have very little value in the diagnosis of silicosis, as they may occur in other diseases or be apparently absent in silicosis, particularly after Stage I. Changes due to silicosis (as seen in frontal views) are most frequently found in the centers of the lung-field and a little above the middle. In lateral views the most marked changes are seen in the posterior inferior part of the upper lobes and the posterior superior portions of the lower lobes. These areas may give the impression of a continuous dense mass, surrounded by aerated pulmonary tissue. It is suggested that dislocation of the trachea due to contraction embarrasses the passage of air and blood, and is a large factor in causing these patients to have dyspnea.

E. M. SHEBESTA, M.D.

THE SINUSES

About the Value of a Roentgen Examination in Otolaryngology. R. Mittermaier. Röntgenpraxis, September, 1935, **7,** 577–588.

The roentgenologist must understand the problems of an otolaryngologist in order to be of help to him. Producing excellent roentgenograms is, in itself, of no particular assistance for a diagnostic problem.

Roentgen examination of the sinuses is the best possible method of demonstrating their anatomy. The extent of pathology may be better shown by roentgenograms than by any other examination. The degree of cloudiness and its localization help to determine the stage of the sinus infection. If there is definite thickening of the bony walls surrounding a sinus, it indicates radical measures to the clinician. Quite often it is possible to demonstrate localized formation of polyps. A general thickening of the mucosa can usually be shown on sinus roentgenograms. In many cases a negative examination is of considerable value to the physician, because the other clinical examinations are questionable. Extension of pathologic findings outside the limits of a sinus with destruction of the wall indicates a malignant tumor. Most fractures which involve sinuses may be clearly shown on roentgenograms with the exception of fractures in the region of the ethmoids, which are very difficult to demonstrate.

In the examination of the mastoids, roentgenograms are of considerable importance. The development and size of the cellular structure must be known to the otologist; also the anatomical extent of the cells. Cloudiness of the mastoid cells, alone, is often seen with simple otitis media and is certainly not, by itself, an indication for surgery. Roentgen examination in the early stage of mastoiditis is of very little clinical value, and of help only as a comparison with later films. Of very great importance is the roentgen examination in mastoiditis with progressive bone destruction. This change may be seen in the third or fourth week. One may see extensive areas of breaking down in mastoids with only slight clinical symptoms. In such cases roentgenograms are the only real diagnostic means for correct treatment, that is, surgery. Cholesteatomas may be demonstrated on roentgen films, if they are not too small. Roentgenographic examination has shown that a mastoid with well-developed and aerated cells is a field for acute otitis media and mastoiditis, while the small cellular type containing only a little air is the basis for development of chronic otitis media. Tumors and some of the fractures of the petrous portion of the temporal bone may be shown by a special technic. Interpretation of roentgenologic findings in this field is possible only with adequate knowledge of the clinical picture and clinical course.

HANS W. HEFKE, M.D.

THE SPINE

Hemangioma of the Vertebra. N. Porro. Archivio di Radiologia, March-April, 1935, **11,** 143–151.

This is a clinical and roentgenologic report of a case of hemangioma of the fifth dorsal vertebra. The patient is still under treatment with x-ray.

E. T. LEDDY, M.D.

Progressive Atlanto-axial Dislocation. Edgar A. Kahn and Luis Yglesias. Jour. Am. Med. Assn., Aug. 3, 1935, **105,** 348–352.

These authors review a series of cases largely to illustrate the results gained from different methods of surgical treatment.

At the time of the original trauma, the common lesion is a fracture of the odontoid process at its base and loosening of the atlanto-axial ligaments with the exception of the strong transverse ligament. The forward displacement at first may be so slight that it is not recognized in the roentgenogram and the fractured odontoid process may not be apparent without a special technic. It is just at this time that immobilization is so essential to prevent subsequent disaster. After the condition has advanced and is easily recognized, conservative treatment by traction or immobilization may be tried; but in cases in which forward slipping progresses or recurs, operative surgery must be considered whether or not pressure myelitis has developed. In atlanto-axial dislocation, one should ever bear in mind the possibility of further progression. The shallow, broad articulating surfaces with the laxness of the ligamentous attachments between these vertebræ predispose to increased forward slipping when the odontoid process has been fractured. When symptoms of spinal cord compression develop and are not rapidly relieved by traction, removal of the arch of the atlas is imperative. Solid bony fusion guarantees greater safety.

CHARLES G. SUTHERLAND, M.B. (Tor.)

THE TESTES

Teratoid Tumors of the Testis. Archie L. Dean, Jr. Jour. Am. Med. Assn., Dec. 14, 1935, **105,** 1965–1971.

Ewing's theory that all teratomas arise from sex cells, most frequently situated in the rete testis but sometimes present in the tunica albuginea, has the widest acceptance. The sex cells are totipotent and for this reason may produce any of the tissues derived from the three primary germ layers. There seems to be a tendency for one type of tissue to outgrow the others, because in most tumors either one tissue predominates or only one tissue is found.

The embryonal teratomas are by far the most common type. Adult teratomas comprise less than 10 per cent. The natural history of the intermediate type of tumor is that of the embryonal portion. The embryonal teratomas are noted for their aggressive qualities and give rise to rapidly growing metastases. In the diagnosis the use of the Aschheim-Zondek test is of value only when it is correctly interpreted.

When there is no evidence of metastases, primary tumors should be irradiated (from four to six weeks) and then removed.

In practice, pre-operative irradiation has been valuable. Irradiation is the best treatment in all stages of the disease.

CHARLES G. SUTHERLAND, M.B. (Tor.)

THE THORAX

Some Roentgenologic Studies of the Dynamics of the Thorax. (Chairman's Address.) J. W. Pierson. Jour. Am. Med. Assn., Aug. 10, 1935, **105,** 399–401.

The most potent force acting within the thorax is the negative intrathoracic pressure. It is absolutely essential to the normal expansion of the lungs and, if it is not maintained, diminished lung capacity must ensue. Another important factor is the elasticity of the lungs, which, acting in conjunction with the negative intrathoracic pressure, serves to keep the thorax filled. This is true in the presence of abnormal as well as of normal conditions. Whenever diminished lung volume occurs, the compensatory mechanism of the chest, acting chiefly through the negative intrathoracic pressure, seeks to establish an equilibrium by reducing the size of the thorax and causing dilatation of the normal lung tissue. The compensatory dilatation of the lungs becomes progressively greater the longer the abnormal condition persists, until finally it causes the normal lung to become large enough to restore the original size of the thorax. This mechanism works in exactly the same way in all cases of diminished lung capacity from whatsoever cause, whether congenital absence, atelectasis, or surgical removal of a lung.

The author suggests the abandonment of all attempts to reduce the size of the thorax following the removal of all or a part of a lung.

Several essentials are necessary in order to permit of the proper functioning of the processes of restitution. First, the lung must be capable of expansion; second, the mediastinum must be patent.

The results obtained in the operative cases quoted would seem to justify the technic, which is designed to utilize the compensatory mechanism of the thorax. Furthermore, preservation of the thoracic cage provides protection for underlying structures, aids in early restoration of the normal physiologic functioning of the thorax and avoids the necessity of a deforming operation.

CHARLES G. SUTHERLAND, M.B. (Tor.)

THE TONSILS

Radiation Therapy of Lymphoid Cell Angina (Tonsillitis). A. Kahlstorf. Strahlentherapie, 1935, **54,** 459.

The author reports a case of a male 24 years of age who developed a fairly severe tonsillitis at the end of April. Because the symptoms continued over a long period of time, the patient was finally admitted to the hospital early in June. The blood examination showed 16,000 leukocytes with 80 per cent monocytes: 275 r were given on June 16, 220 r on June 22, and 220 r on July 8 over each tonsillar area with deep therapy

technic. By July 11 the leukocyte count had dropped to 6,200 with 43 per cent monocytes. The local symptoms had disappeared after the first exposure. It is recommended, therefore, to use roentgen therapy in cases of this type.

ERNST A. POHLE, M.D., Ph.D.

TUBERCULOSIS, INTESTINAL

The Roentgen Diagnosis of Intestinal Tuberculosis. Julius Rother. Röntgenpraxis, September, 1935, **7,** 589–595.

The author had the opportunity in a large sanatorium to examine 546 patients roentgenologically for intestinal tuberculosis; in 125 of these cases an autopsy was performed, which agreed with the roentgen diagnosis in 88.8 per cent of the cases. This result of roentgenologic examination is much better than any other clinical method in these cases.

Direct roentgen signs of tuberculosis of the intestines are: ulceration, fixation of the walls, swelling of the edges of the ileocecal valve, shrinking of some portion of the intestinal tract, a narrowing of the intestinal lumen, and evidence of peritoneal adhesions. The indirect signs are: disturbances in the motility, spasm, and gas in the small intestines. The typical place for intestinal tuberculosis is the ileocecal region, and its roentgenologic study is most important in suspected cases. Each case should be examined by barium enema and barium meal. After fluoroscopic observation of the colon during the barium enema, films are taken of the colon and of localized, suspected areas. The barium meal might show Stierlin's sign of spasm better than an enema. Ulcers in the distal ileum are rarely demonstrated on roentgenograms, but more or less fixation and stenosis may indicate involvement of the small intestines. The cecum itself shows a funnel-shape rather than the normal semicircular shape. The edges are irregular and may show ulceration. More or less characteristic for tuberculosis is swelling of the edges of the ileocecal valve, which produces a filling defect in that area. Obstruction due to tuberculosis is much rarer than in carcinoma and was seen only three times. The diagnosis of intestinal tuberculosis by roentgenologic examination is of more value than other clinical examinations.

HANS W. HEFKE, M.D.

TUBERCULOSIS PULMONARY

Lower Lobe Tuberculosis: A Review. Charles E. Hamilton and Harry Fredd. Jour. Am. Med. Assn., Aug. 10, 1935, **105,** 427–430.

Experience has taught that chronic lesions in the upper lobe should be considered tuberculous until proven otherwise. Lesions in the lower lobe, on the contrary, should be considered non-tuberculous until proven otherwise (Fishberg). The authors review the opinions of many observers and state that the above opinion has been accepted so generally that even to-day primary basal involvement is regarded as extremely rare. In the wards for tuberculous adults at Kings County Hospital from September, 1934, to January, 1935, they have had ten proven cases of sole involvement of a lower lobe due to tubercle bacilli, an incidence of over 3 per cent. Lathrop and Lyman found that 67 per cent of lower lobe lesions were due to tuberculosis and only 33 per cent due to other causes. Dunham and Norton were of the opinion that basal lesions occurred only in those patients who had tuberculosis elsewhere in the body, and that basal lesions are virulent. Pancoast expressed the belief that lower lobe tuberculosis was an atypical manifestation of miliary tuberculosis and was due to blood stream infection. The authors were unable to agree with these statements. Of their 10 patients, only one had died, and she was colored. The others had been treated by collapse therapy and phrenicectomy and were all doing well. The history and the clinical course were the most valued aids in making the tentative diagnosis. Negative sputum examinations do not rule out lower lobe tuberculosis.

CHARLES G. SUTHERLAND, M.B. (Tor.)

Roentgen Therapy of Ambulatory Patients with Pulmonary Tuberculosis. T. v. Vasshegyi. Strahlentherapie, 1935, **54,** 696.

The author used roentgen therapy in 25 cases of a productive type of tuberculosis of the lungs. Technic: 178 kv., 0.5 mm. Zn + 0.5 mm. Al, 30 cm. F.S.D., 88 r (in air). A large field was applied over the diseased area and a series of treatments consisted of five or six sittings at weekly intervals. The weight, physical findings, x-ray findings, sputum, blood picture, sedimentation velocity of erythrocytes, and temperature before and after treatment were carefully recorded. The findings in all 25 patients are presented in a table. It is concluded that roentgen therapy is of value if used in selected cases.

ERNST A. POHLE, M.D., Ph.D.

TUMORS (DIAGNOSIS)

The Simulation of Intracranial Tumor by Lead Encephalopathy in Children, with Remarks Concerning the Surgical Treatment of the Latter. Paul. C. Bucy and Douglas N. Buchanan. Jour. Am. Med. Assn., July 27, 1935, **105,** 244–250.

A group originally thought to be cases of intracranial neoplasm, but subsequently classified as examples of "serous arachnoiditis" because of the absence of any signs of tumor at operation, have recently been shown to be examples of intoxication with lead.

A boy, aged 2 years, was operated on for a possible mid-line tumor of the posterior cranial fossa; postoperatively a diagnosis of "serous arachnoiditis" was made and later roentgenograms taken of the various long bones revealed marked bands of increased density at the ends of the diaphyses; under treatment to facilitate the removal of lead from active circulation and hasten its storage in the bones the dense bands at the ends of the bones rapidly widened.

A somewhat similar experience is reported in the case of a girl, aged 5 years.

A review of the literature elicited reports of vomiting, visual disturbances, delirium, stupor, coma, convulsions, often elevated arterial pressure, choked optic discs, and separation of the cranial sutures, due to cerebral edema and increased intracranial pressure.

The easiest and most rapid method of rendering possible the diagnosis of lead encephalopathy is the demonstration of the presence of lines of increased density at the ends of the long bones.

CHARLES G. SUTHERLAND, M.B. (Tor.)

A Case of Psammoma of the Anterior Cranial Fossa. Karl Goldhamer. Fortschr. a. d. Geb. d. Röntgenstrahlen, July, 1935, **52,** 17–30.

A partly calcifying, partly destructive tumor was discovered in a boy, 12 years old, involving the lamina cribrosa and the planum sphenoidale, extending to the left to the upper orbital fissure and the optic canal. Observations are reported covering six years, during which roentgen therapy was applied at various intervals to a total of 7,700 r; in addition, a decompression operation was done in the temporal region. During the first year the tumor grew considerably in size and also showed markedly increasing calcification. Later on it reduced very appreciably, its lime content diminished markedly, and it showed partial irregular ossification. The differential diagnosis and the result of roentgen therapy are considered critically. It is assumed that the tumor in all probability represents a malignantly degenerated endothelioma of the dura or a primary osteosarcoma of round-cell type.

H. A. JARRE, M.D.

Ewing's Tumor. Aldo Piergrossi. Archivio di Radiologia, March-April, 1935, **11,** 152–164.

The author in presenting a case of Ewing's tumor, states that a clinico-radiologic diagnosis is not possible when the tumor lies in the epiphysis of a long bone or in a short or flat bone, and that the histology of the lesion is not an individual one. He, therefore, feels that the diagnosis of Ewing's tumor should be reserved for the condition in the diaphysis of the long bones described by Ewing, until the histology of the lesion is better defined.

E. T. LEDDY, M.D.

TUMORS (THERAPY)

The Post-operative Roentgen Therapy of Malignant Tumors of the Testicles and the Treatment of Their Metastases. Karl Overhof. Röntgenpraxis, October, 1935, **7,** 693–699.

The Roentgen Institute of the University of Frankfort (Holfelder) reports 26 cases of testicular tumors and their roentgen treatment, seen since 1927.

There was a 5-year cure in 28.6 per cent of the cases, which is considerably better than the end-results of surgery alone. The technic of prophylactic therapy is: three fields, one at the corresponding groin, one each to front and back of the corresponding side of the abdomen (10 × 15 cm.); five times 330 r are given to each field in 5-day cycles. The series is repeated, if possible, in from four to six months.

Metastases are treated similarly and the primary results are good; the end-results, however, are usually not good.

The conclusions are that every testicular tumor should be irradiated prophylactically soon after surgery.

HANS W. HEFKE, M.D.

THE UTERUS

Our Experience in the Treatment of Carcinoma of the Uterus, with Special Consideration of Carcinoma of the Cervix. R. Freisfeld. Strahlentherapie, 1935, **54,** 393.

At the Woman's Clinic of the University of Muenster, 357 cases of carcinoma of the uterus were treated during the period from 1925 to 1934. Of these patients, 317 had carcinoma of the cervix and 40 had carcinoma of the uterus. Operable cases were referred to the surgeon and received x-ray deep therapy post-operatively. All others were treated by a combination of radium and x-rays. One hundred cases of carcinoma of the cervix were observed over a period of five years or longer; the absolute percentage of cure amounted to 22. Thirteen patients with carcinoma of the fundus outlived the five-year period; five were operated on and lived; eight were treated by irradiation, with two alive at the end of five years. This amounted to a total cure of 53.5 per cent. The author points out that the results obtained in Group III were quite remarkable and this in spite of the extensive involvement found in these cases.

ERNST A. POHLE, M.D., Ph.D.

VENEREAL DISEASES

The Diagnosis of Congenital Syphilis. A. H. Parmelee and L. J. Halpern. Jour. Am. Med. Assn., Aug. 24, 1935, **105,** 563–565.

Roentgenologic evidence of bone lesions characteristic of congenital syphilis is the only other known diagnostic sign of the disease other than the clinical and serologic evidences. A large number of infants born of mothers known to be syphilitic show no clinical symptoms of the disease during the first few weeks of life. Likewise a comparatively large number give negative serum reactions.

In a series of studies the authors established the predominant importance of the roentgenologic evidence of osseous syphilis during early infancy. In 95 per cent of positive cases a diagnosis could be made through the evidence of osseous lesions as revealed by roentgenograms. Only 29 per cent of the same series gave positive serologic tests.

Periostitis is almost never present in the new-born; it becomes moderately frequent by the sixth week, and is present in more than half of the cases showing osteochondritis by the third month. It is extremely rare for periostitis to occur as the only change in the bones of syphilitic infants.

The authors chart the relative incidence of osteochondritis alone, osteochondritis and periostitis, and periostitis alone.

CHARLES G. SUTHERLAND, M.B. (Tor.)

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